AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

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NOVEMBER, 1957

Precision Metal Molding

PMM

INCLUDING DIE CASTINGS MAGAZINE

DIE CASTINGS

INVESTMENT CASTINGS

PERMANENT MOLD CASTINGS

PLASTER MOLD CASTINGS

POWDER METALLURGY

SHELL MOLD CASTINGS

Aircraft quality castings are now being made in titanium and zirconium. see page 3.

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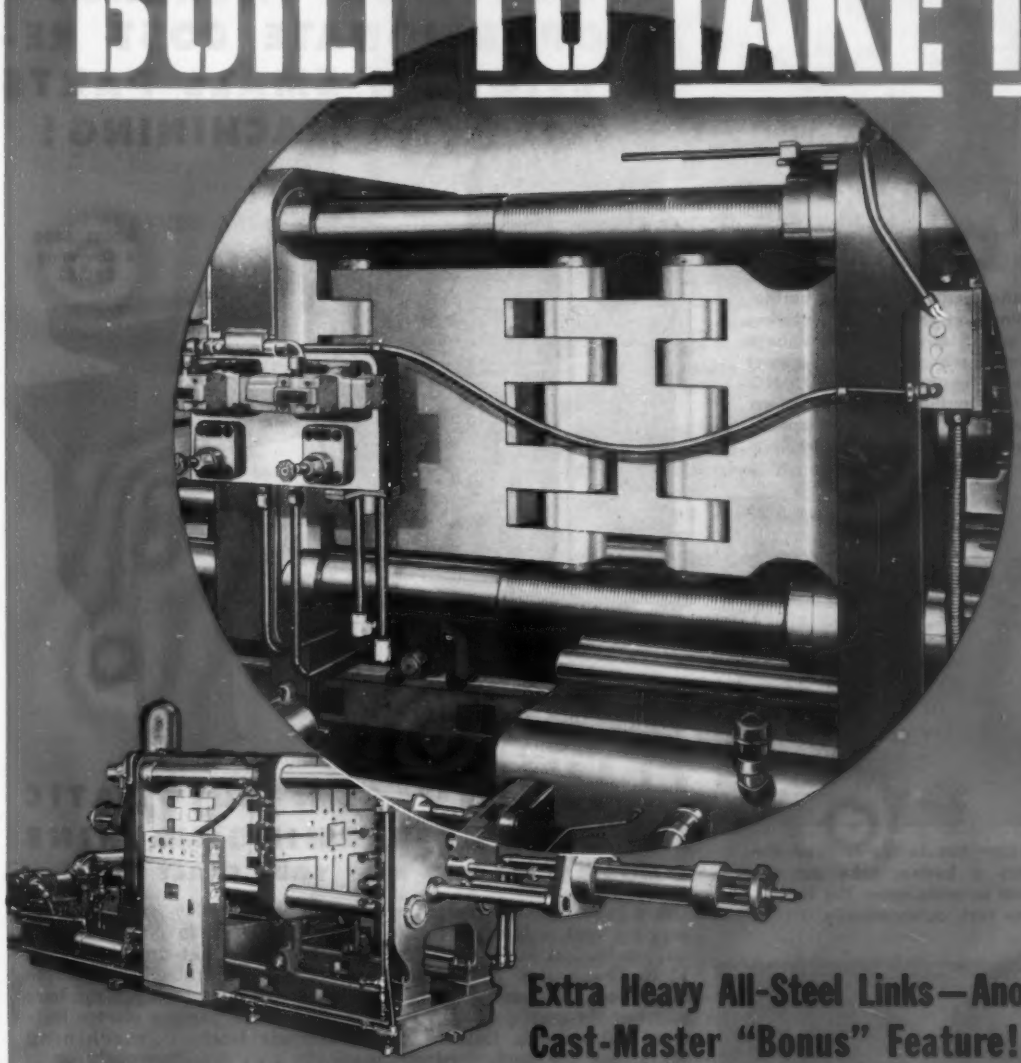

Extra Heavy All-Steel Links—Another Cast-Master "Bonus" Feature! . . .

The story of Cast-Master quality is a story of "bonus" features — like the link system shown here. Cast-Master links are super-rugged — all-steel — machined — with wide spread for positive lock-up, and multiple shear points to eliminate link pin breakage. Result? — more precision — lower maintenance costs for Cast-Master owners. To get the complete "bonus" story, send for the new Cast-Master catalog. It describes exclusive Cast-Master developments, gives detailed specifications on eight new models that are setting the pace for the industry.

MIDWEST REPRESENTATIVE: C. W. Stone Co., *Minneapolis 3, Minnesota*

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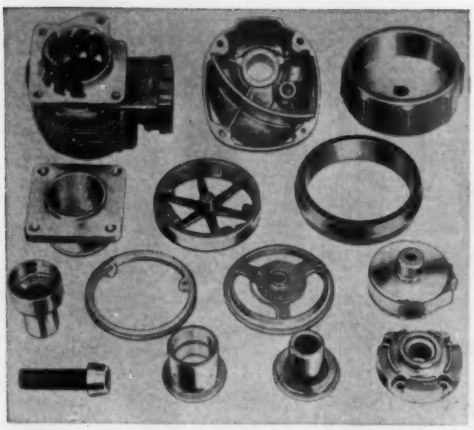
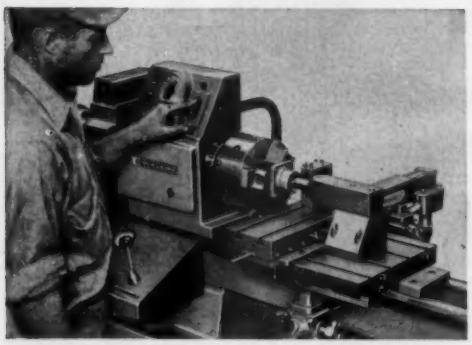
500%

PRODUCTION INCREASE— PROPORTIONATE COST REDUCTION IN SMALL PARTS MACHINING!

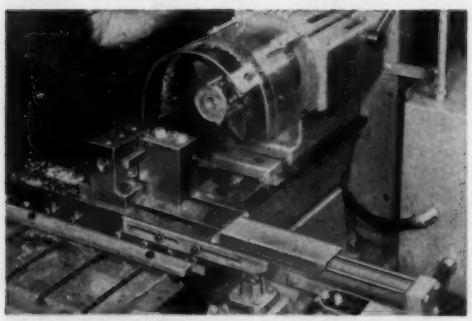


If your operations call for turning, boring, facing, forming, grooving, chamfering, beveling, or cut-off of parts such as these (pieces shown merely suggest the almost endless variety), there's a CLAUSING Hydra-Cycle for handling these operations in combination or singly, with great speed, to close tolerances, and at low cost.

MODEL 6405
4 Operating CYCLES



All the operator has to do is load the machine, press a button, take out the machined piece seconds later. The Hydra-Cycle does the rest, automatically.



Six surfaces are being machined in the operation shown above. As is the case with most jobs that can be handled by the Hydra-Cycle, the tooling required is simple, inexpensive.

THE NEW CLAUSING SEMI-AUTOMATIC BORING AND TURNING MACHINE

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Users report production increases of 200% to 500%, with corresponding cost reduction, and jobs have been held to .0002 tolerance on production runs. Average job change and set-up takes from 15 to 30 minutes. No special jigs or fixtures required . . . simple block tool holders, carbide insert bits and standard boring bars will handle most jobs. Operator merely loads, presses starter button, and unloads finished pieces *seconds later* . . . machining operations are performed automatically . . . simultaneously or in continuous sequence. A time and money saver on short as well as long production runs.

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Simply send us complete data . . . drawings of rough and finished part, indicating material, tolerances, finish required, production rate — and, samples of finished and unfinished parts. Our engineering department will gladly make recommendations for the use of the Hydra-Cycle model best suited to your requirements. No obligation. Mail to Hydra-Cycle Department, Clausing Division, Atlas Press Company, Kalamazoo, Michigan.

CLAUSING

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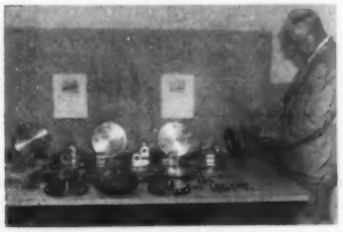
COVER STORY



TITANIUM AND ZIRCONIUM can be cast in grafite molds. The castings meet all aircraft requirements for strength and soundness. But commercial uses are developing for castings in these metals. Here, O. H. Hinsdale, president, Oregon Metallurgical Corp., is inspecting a group of cast titanium components for a Dorr-Oliver thickener. See page 48.

FEATURE ARTICLES

35 **FORECAST OF POWDER METALLURGY INDUSTRY**
If the industry engages in aggressive selling it can expect a moderate gain in business.

37 **A FORECAST FOR INVESTMENT CASTING**
The curtailment of aircraft buying will probably be reflected in a decrease of about 10% in 1958 business.

39 **PARTS MADE OF SELECTED HIGH STRENGTH STEELS**
The investment casting of high strength steels will open an entirely new market.

42 **EXTREME PRECISION IS POSSIBLE**
Powder metallurgical techniques can accomplish very high precision, but only where much higher than usual costs can be tolerated.

44 **CASTING BIG ENGINE PARTS**
Large castings with complex coring can be cast by the permanent mold casting process.

46 **IN EITHER RAIN OR SHINE DIE CASTINGS DO THE JOB**
Through the use of aluminum die castings these low priced instruments are now available for the amateur weatherman.

48 **CAST TITANIUM AND ZIRCONIUM PARTS**
Techniques for casting both titanium and zirconium have been developed. The castings are strong, sound and moderately priced.

50 **A STEP TOWARD AUTOMATIC DIE CASTING**
With the development of an automatic transfer mechanism, automation in the die casting foundry is one step closer.

79 **WAYS TO CONTROL TEMPERATURES ACCURATELY AND ECONOMICALLY**
Temperature control is vital in all of the PMM industries. Here is a brief introduction to the different types of instruments used.

82 **HEAT CONTROLS USED IN POWDER METALLURGY**
The control of temperature, and gas flow, is vital in this industry. Without proper control scrap losses would destroy profits.

85 **HEAT CONTROL IN INVESTMENT CASTING**
The critical requirements and the complexity of castings made makes temperature control vital.

91 **VACUUM SINTERING — PART II**
The second of a three part article dealing with the possible use of very low pressures in the sintering of powdered metal parts.

FINISHING SECTION

55 **EXTENSION SOLVES TAPPING PROBLEMS**
Particularly in machining die castings, many small diameter, hard to reach holes must be drilled and tapped.

56 **HERE ARE 10 STEPS IN BLACK ANODIZING ALUMINUM DIE CASTINGS**
A step by step procedure for securing a clear black anodized finish on die castings.

59 **CORRECT USE OF SELF THREADING FASTENERS**
For many fastening jobs a self-threading nut will speed up assembly operations and reduce rejects.

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BETWEEN THE LINES

the editor's viewpoint on articles in current and forthcoming issues

TEN STEPS IN BLACK ANODIZING of aluminum die castings are outlined in a feature article this month. Although some say it can't be done, General Railway Signal Company has been doing the "impossible" for several years . . . they're getting a good, uniform black anodize on aluminum die castings. PMM brings you the details starting on page 56.

TEST BARS DON'T FLY, say skeptical metallurgists in the aircraft industry, but even skeptics will be impressed with the evidence showing reproducibility of properties in cast high strength steels starting on page 39. Investment castings in these high strength steels are finding many new uses in the aircraft industry. The information contained in this article will serve as valuable reference material for aircraft engineers.

HOW FAR AHEAD DO YOU PLAN? Republic Steel's economists are studying market conditions 10 to 30 years in the future. The company is betting millions on the accuracy of these forecasts. Because the markets for castings are closely related to the markets for steel goods, PMM has obtained a long range forecast for automobiles, appliances, business machines, etc. written by a Republic executive. Whatever type of metal product you manufacture, we're sure you'll be interested in this long-range forecast in our December issue.

THE PLACING OF INSERTS IN A DIE CASTING DIE slows production. Now, a system for placing stacks of laminations in the dies for casting electric motor rotors has been put into production. . . it may be applicable for the placing of other types of troublesome inserts. The first published report on this new ingenious setup is contained in this issue of PMM beginning on page 50.

PROTECTIVE CONVERSION COATINGS for zinc and aluminum die castings will be the central feature of PMM's December Finishing Section. Full technical discussion of chemical protective coatings, including . . . what they are, how to apply them, and why they are used.

TEMPERATURE CONTROL IN THE PMM INDUSTRIES requires a high degree of precision. It is one of the characteristics of the castings and sintering processes that extensive instrumentation is needed to measure, indicate and control heat during processing. For this reason, PMM has asked five leading authorities for articles on this subject. Three of them appear in this issue starting on page 79 and the remaining two articles, covering die casting and permanent mold casting, will appear in December.

Two Important Announcements on VACUUM DIE CASTING from REED-PRENTICE

REED Announces Exclusive Rights to Vacuum Die Casting

In an agreement just concluded with David Morganstern, Vice-President of Nelmor Manufacturing Company, Reed-Prentice has been granted sole rights to existing patents on vacuum die casting equipment. Mr. Morganstern will work with REED as a consultant.

Now you can get vacuum die casting equipment — for both zinc and aluminum, as either original equipment or conversion units — as a REED exclusive. Contact your Reed-Prentice Sales Engineer today for full details.

REED Announces A New Aluminum Vacuum Die Casting Unit

The Vacufeed, a new vacuum die casting system for aluminum, features fully automatic feeding. This new unit gives you, with aluminum, all the advantages of thinner, stronger castings already proved by the zinc Vacucast system. The new Vacufeed is now being run experimentally on a production basis, and full details will be announced soon.

Your Reed-Prentice Sales Engineer can give you data and preliminary specifications on the new aluminum Vacufeed unit. Contact him today, or write to our main office in Worcester.

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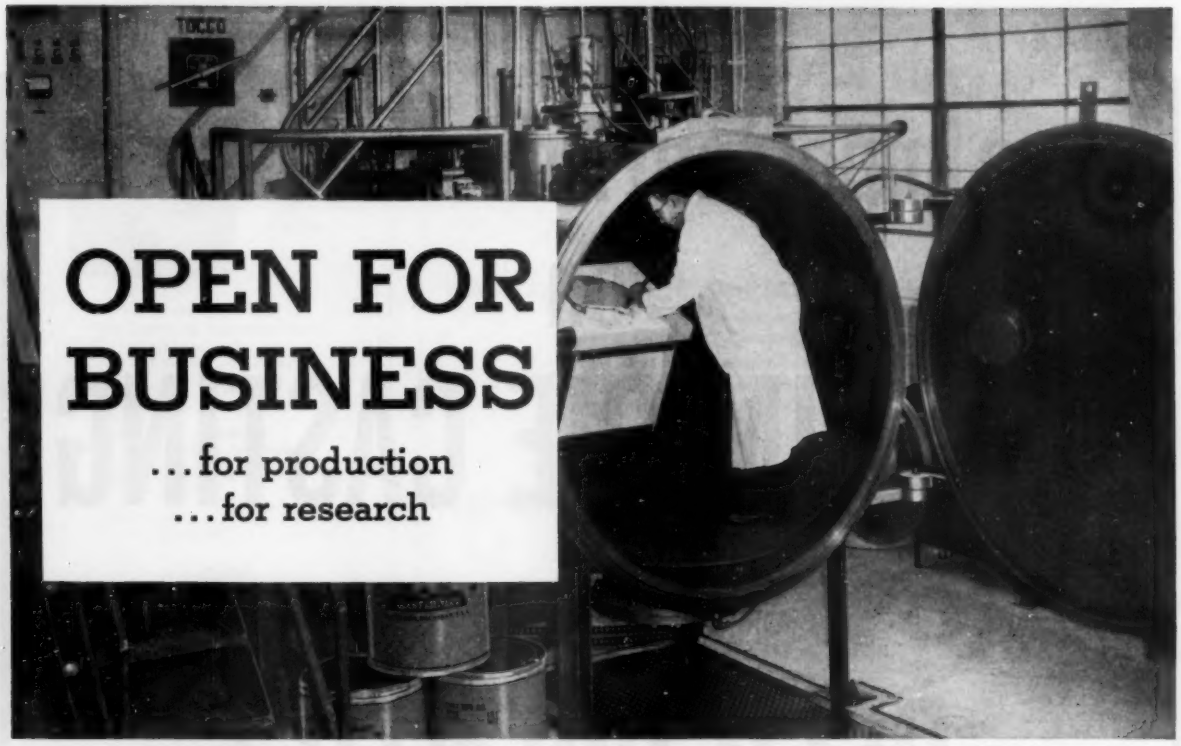

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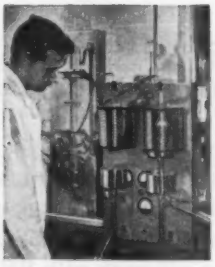

Precise carbon analysis is another UltraMet test for chemical quality. Additionally, tensile properties, creep tests, Rockwell hardness, bent wire and other tests safeguard perfection throughout production.

MasterMet alloys are produced by air-melting in modern high-frequency furnaces. The chemical analysis of each melt is certified to your specifications — exactly produced to compensate for melting losses.

For full particulars, write for our new bulletin on Vacuum Melting and Air Melting facilities and alloys . . . plus details on new "tight" specs on Armco 17-4PH.

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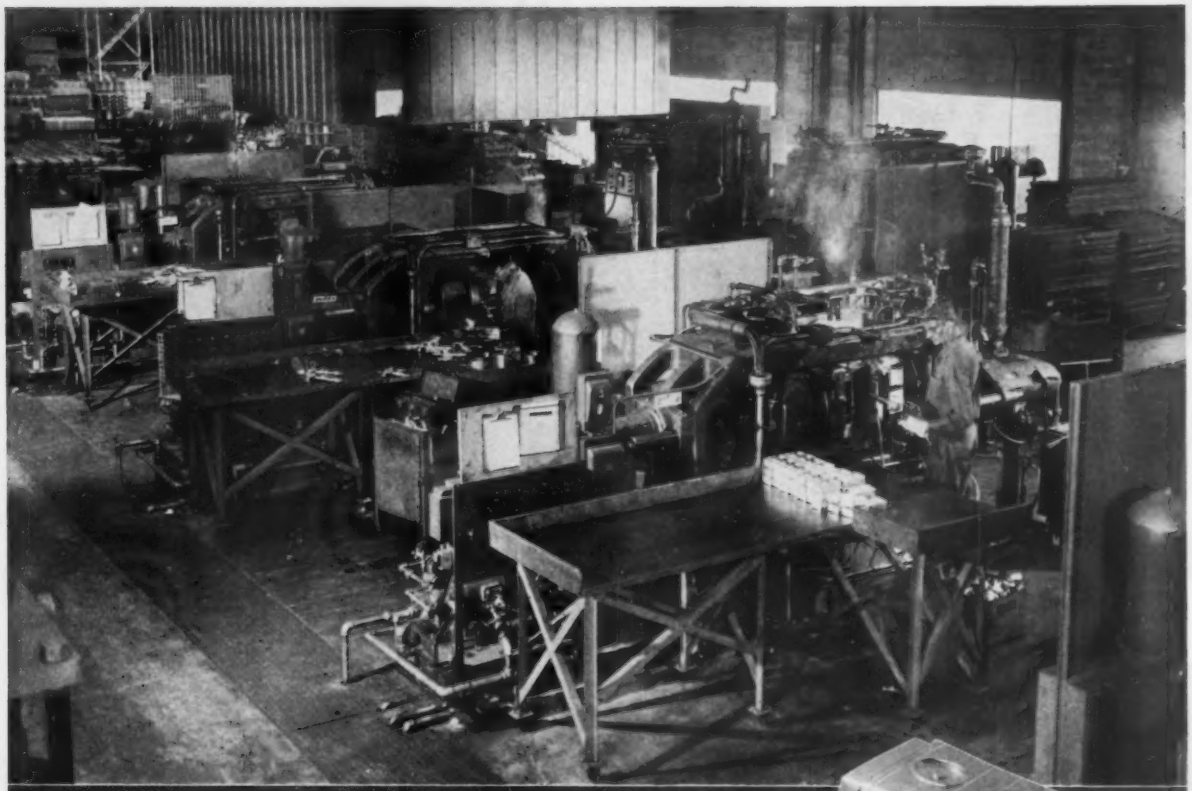

Now Bell and Howell... die casting on LESTERS...saves over 25% on this typical casting!

Bell and Howell Company, the only major photographic equipment manufacturer doing a major part of their own die casting, tell a story that is classic as a testimonial to the wisdom of installing Lester machines.

Mr. W. D. Johnson, Die Casting Manager of the company, has been working on the project since its inception, and was there when the first machines were installed—well over two years ago.

Speaking from this vantage point about the housing for their Monterey 8mm movie camera shown here, he says, "We had never done any die casting previous to our set-up of these machines a little over two years ago, and began production on this rather difficult casting on a high monthly requirement...This production schedule has continued since that time. *The savings to Bell and Howell on this particular casting have been well above the average savings of approximately 25% for the entire die casting operation."*

•

Complete details on the full line of Lester Die Casting Machines are available in Bulletin 101. *Write for your copy TODAY.*

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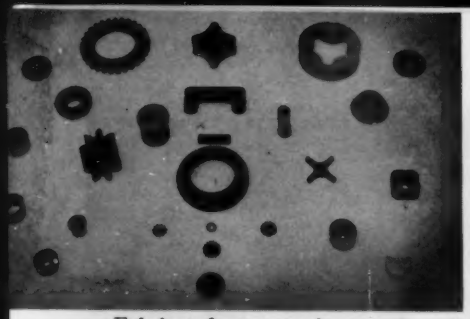
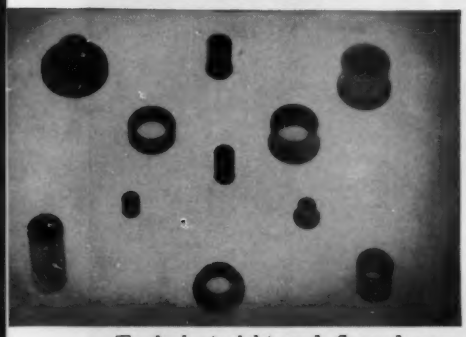
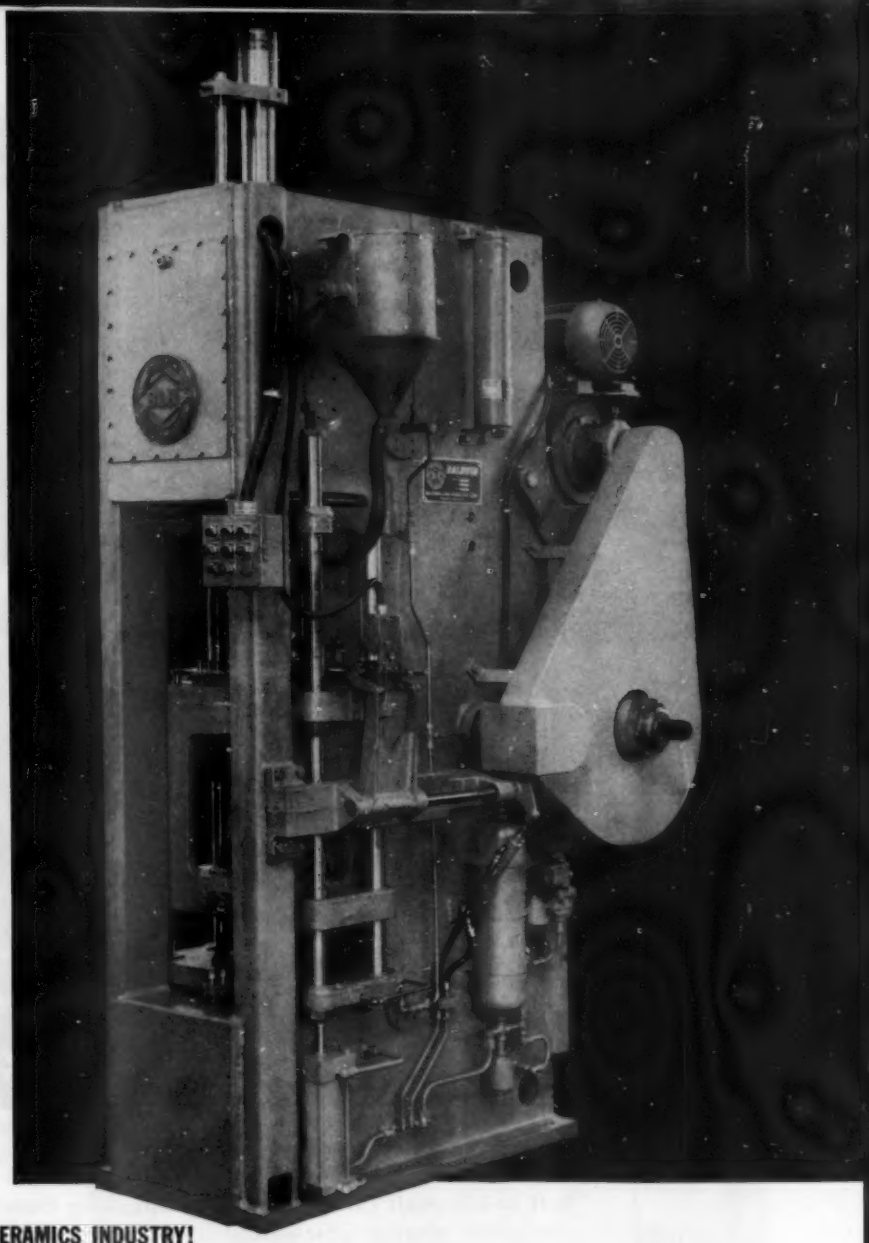


Fabricated parts and gears formed on Baldwin Compacting Presses.



Typical straight and flanged powdered metal bushings made on Baldwin Compacting Presses.

Other parts being made at United States Graphite on Baldwin presses. The double hub and counterbored parts are test pieces. Others are production items.



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Its 1-piece frame and floating die deliver the same uniform pressure, the same rigid 4-point guiding, as our regular heavy duty 4-column hydraulic presses. The 50W is designed for versatility—extra motions may be added as requirements become more complex, without the need for additional machining.

Rated pressure of the Baldwin Model 50W is 50 tons, with a 25-ton ejection capacity. Stroke is adjustable through its entire fill range of 0 to 4½ in. For complete details, including specifications, write to the Hamilton Division, B-L-H Corporation, Hamilton, Ohio.

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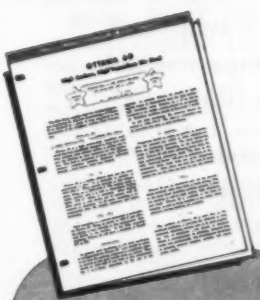

Write for a copy of the OTTAWA 60 BLUE SHEET

This Blue Sheet contains certified data on the physical characteristics of Ottawa 60, prepared from carefully checked laboratory and field service tests. All the information you'll need on methods of handling and heat treatment, etc.

ADDRESS DEPT. PM-85

OTTAWA 60 is a *new* die steel, an A-L "original," developed primarily to deep draw and form stainless steel. As intended, it performs without galling or pickup and shows exceptional wear resistance in that service. We have plenty of case histories to show you in proof.

But *wherever* you use Ottawa 60 draw dies—not just on stainless steel—this high-carbon, high-vanadium alloy comes through for you. Illustrated above are the first and second draws on transformer housings, produced from .037" gauge SAE 1010 strip. The company formerly used dies made of 5% chrome air-hardening die steel—and later a more highly alloyed material—without ever getting more than about 2000 pieces before the dies began to show gall marks and pickup, and parts were rejected due to scoring, breakage and oversize. *Dies made from Ottawa 60 forgings cured that! Results after 25,000 pieces showed no pickup and no wear on punch or die.*

● You can solve many a problem and save real money with Ottawa 60 draw dies! Write for information or call in our Field Service Staff to help you get started. ***Allegheny Ludlum Steel Corporation, Oliver Bulding, Pittsburgh 22, Pa.***

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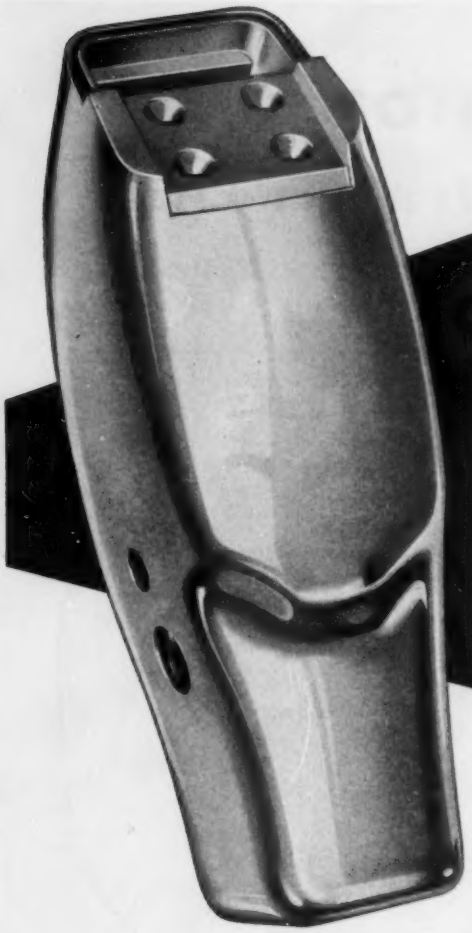

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Republic is the world's only producer of iron powders with predictable dimensional characteristics after sintering operations. The process by which these powders are made is called *Controlled Dimensional Factor* or CDF, an exclusive Republic development.

Simply stated, CDF means that in the presence of copper, Republic Iron Powder—depending on type—can be made to grow, shrink or remain stable within acceptable tolerance limits. These powders have been designated as Type "G" for growth, Type "N" for normal or zero dimensional change, and Type "S" for high shrinkage after sintering.

CDF opens a new era for fast, economical production of iron powder sinterings. It frees the designer, tool engineer, and fabricator from the idiosyncrasies of a process, without the necessary addition of other materials. CDF eliminates the problem of not knowing how a powder will react before a part or tool is designed or a production run is started.

Designers can hit goals on projected or production items. Consistently uniform shrinkage and growth characteristics help in die design and in establishing final dimensions of parts. Tool engineers can design tools to part print dimensions with the assurance that tolerances, transverse to the direction of pressing, can be held within ± .001 inches per inch. Fabricators can produce consistently uniform sinterings faster and at minimum cost.

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60 CYCLE INDUCTION MELTING

A famous metallurgist once wrote: "50% of all rejects can be traced to faulty melting and pouring." When molten metal is overheated, important alloy ingredients are lost by burning. Castings or billets may be porous from combustion gases absorbed by the molten metal. Frequently, unwanted alloy ingredients are picked up from the containers used in melting. If the temperature of molten metal flowing into a mold strays from the optimum, defective castings will result. In a quiet melt alloy ingredients may not dissolve properly, and the metal cast will not meet specifications. Finally, there is the problem of nonmetallics suspended in the melt which cause occlusions and other difficulties in the end product.

60 CYCLE INDUCTION MELTING, properly applied, is probably the biggest single step that can be taken to overcome these traditional melting problems. The method is unique in its combination of two factors: Heat is generated only in the molten metal, and the entire melt is stirred by electromagnetic pressure. Furthermore, high melting rates can be concentrated in a small space. —No part of the furnace is hotter than the metal. Combustion gases are absent and controlled atmospheres can be used. The container is constructed of refractories inert to the molten metal. Temperature control of unprecedented precision is inherent in the method. Electromagnetic stirring assures complete dissolving of all ingredients and a uniform alloy. Suspended nonmetallics are deposited in the electromagnetic pressure area.

These are basic reasons why 60 CYCLE INDUCTION MELTING has had such a spectacular growth in the postwar period. Modern plants require high production rates with controlled quality, yet can assign only a minimum of skilled labor to each operation. 60 CYCLE INDUCTION MELTING minimizes hard labor in melting. It enables process control to substantially decrease the effect of human error. Cost reductions are reflected throughout each step of fabrication of a casting or billet to its end use.

60 CYCLE INDUCTION MELTING, firmly established for thirty years as the predominant production method for melting brass, has recently been applied on a much larger scale. In the last ten years, as new furnace designs became available, the method has been rapidly adopted by many progressive companies in the fields of aluminum die casting, aluminum extrusion, aluminum wire, aluminum coating, leaded copper alloy casting, zinc die casting, and galvanizing of strip in the steel mills. Well over one thousand 60 CYCLE INDUCTION MELTING furnaces are now operating in these new fields.

Our 60 CYCLE INDUCTION MELTING furnace takes many different forms to meet the needs of all these industries. Unit production rates now range from 150 pounds to 40 tons per hour. We specialize in the development, design, and manufacture of standard and custom-built furnaces to meet each requirement. If there is a production melting problem in your operation which may benefit from a basic change in method, we should be glad to discuss the possibilities with you.

ajax

ENGINEERING CORPORATION

TRENTON 7, NEW JERSEY

Associated Companies: Ajax Electric Company Ajax Electrothermic Corp.

For more information circle No. 5 on the Reader Service Card

NEW HAMMARLUND RADIO RECEIVER

FEATURES DIE CAST PANEL

CASE HISTORIES FROM MT. VERNON FILES

In their new HQ-100, Hammarlund Manufacturing Company brings to reality a completely new concept in receiver design. It is beautiful. It gives the radio amateur the utmost in performance. And it sells for far less than other comparable short-wave receivers.

A chief reason for this great economy is the front panel—the first die-cast panel in the history of commercial radio equipment. This 3-dimensional, channeled die-cast aluminum panel is used because it affords both rigidity and great structural strength. To produce its equivalent in sheet metal —the currently used method in the industry—*would cost 4 times as much.*

This remarkable panel is the result of thorough collaboration between Hammarlund and the die-making experts at Mt. Vernon, who made practical suggestions which simplified its design.

In addition to the production economies of die casting, the panel benefits from these other important advantages: (1) Die casting's inherent accuracy enables Hammarlund to assemble the chassis with what they call "camera precision construction." (2) All rejects on the production line are eliminated. (3) In finishing—die casting enables them to work out clearly divided areas for the elegant two-tone treatment that is both functional and beautiful. Also, the amount of finishing is minimized.

When you are out to break precedent, as Hammarlund did, you too can find the kind of skilled help you need in the complete service available from Mt. Vernon's coordinated designing, die-making, casting, and machining facilities, all under one roof, which can supply die cast zinc and aluminum parts ready for use. A switch to a die casting service like ours may be your next step. Let's discuss it.

MT. VERNON
DIE CASTING CORP.
STAMFORD, CONNECTICUT

SALES REPRESENTATIVES

Mr. Grant Eller
6 East 194th St., Cleveland, Ohio

Mr. Jerome J. Theobold
9 East Genesee St., Skaneateles, N. Y.

Carey and Gordon
919 St. Paul St., Baltimore 2, Md.

Mr. Anker Anderson
Cascade Road, Stamford, Connecticut

Mr. William Sauers
101 Briarcliff Road, Rochester, N. Y.

Mr. David King
230 Grant Boulevard, Syracuse, N. Y.

Mr. George E. Hahl
39 South Munn Ave., East Orange, N. J.

CASTING ABOUT

technical news of applications & processes involving precision metal moldings

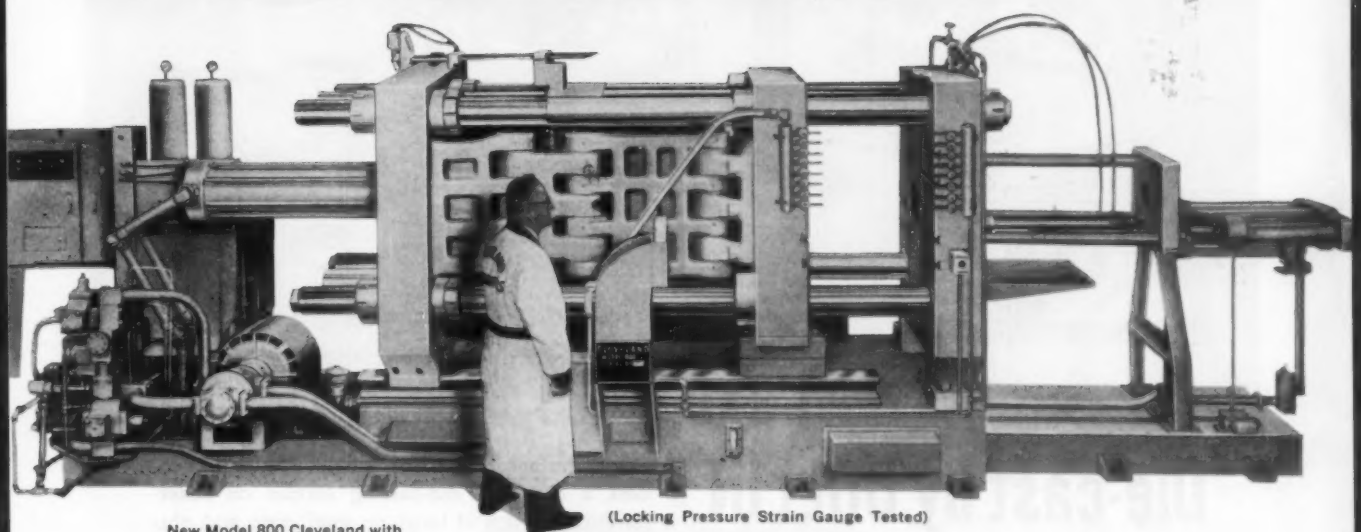
TRAINING SCHOOL FOR MAKING DIE CAVITIES is being operated at the Port Washington, N.Y., foundry of Shaw Process Development Corp. The techniques for casting dies and molds suitable for die casting, forging, extrusion and other metal-forming processes are taught as part of the licensing arrangement for the British-developed Shaw Process. Shown above are a group of trainees including, in the foreground, technicians from a midwestern die casting plant. This process for making cast die cavities is capable of yielding a die cavity from a wood, plastic or metal pattern in a few hours, requiring only grinding of outer surfaces to fit into the die block, and polishing or vapor blasting of the cavity, Among the many firms now licensed to use this process are several who produce die casting dies.

CERAMIC COATINGS FOR PISTONS AND CYLINDERS capable of increasing automobile engine efficiency to 85% were described by Samuel W. Bradstreet of Armour Research Foundation at a recent meeting of the American Chemical Society. By a flame spray technique developed at Armour, where Mr. Bradstreet is supervisor of inorganic technology, metallic oxide coatings from .005 to .015 thick are applied. Use of these coatings on components of jet engines and rockets is said to boost the maximum operating temperature of presently used metals from 2200 F to 4000 F. Commercial use of these coatings on automobile engines would be possible within 18 months, Mr. Bradstreet pointed out, if a manufacturer of automobiles were to underwrite further research. Coatings of metallic oxides on pistons and cylinders help to burn fuel more completely and eliminate or reduce exhaust fumes, he said.

DIE CASTING TERMS IN FIVE LANGUAGES are tabulated in a new glossary published by the Zinc Development Association for the European Pressure Die Casting Committee. According to R. Lewis Stubbs, director of the ZDA, the visit paid to the United States by 30 European die casters in 1954 proved the need for such a glossary for die casters to help keep in touch with work being done in other countries. Some 150 basic die casting terms which do not normally appear in technical dictionaries have been arranged in alphabetical order in English, French, German, Italian and Spanish. Copies of the glossary can be obtained from the Zinc Development Association, 34, Berkeley Square, London, W. 1, England for approximately $3.00.

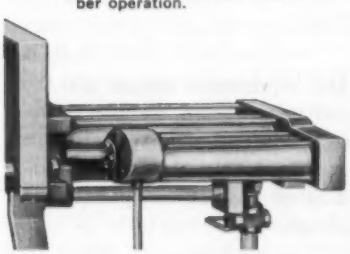
THE RIGHT MACHINING OPERATION required to get a desired microinch finish can now be determined by means of a handy slide chart available free from Micrometrical Manufacturing Company of Ann Arbor, Mich. The new Profilometer slide chart gives typical applications and tolerances on one side of the chart; a compact set of instructions is contained on the other side. Copies of the chart may be obtained by requests sent on company letterhead.

NEW 800 TON CLEVELAND Hydraulic Die Casting Machine



(Locking Pressure Strain Gauge Tested)

New Model 800 Cleveland with cold chamber shot end. Machine weight is 28¼ tons. Readily converts to hot chamber operation.



Incorporating an intensifier, new Cleveland cold chamber shot end provides high pressures on metal; high plunger speeds (both adjustable).

Now available for producing castings up to 20 lbs. aluminum, 46 lbs. zinc. This *big*, newest Cleveland has 55″ x 54″ die plates; 33″ x 33″ space between tie bars; 38″ max. to 20″ min. die thickness; 15″ to 24″ die opening. Massive toggle system, with 7″ dia. tie bars and cross head guide bars, 9½″ thick platens, insures extreme rigidity and positive die alignment . . . with *guaranteed* 800-ton locking pressure!

A highly advanced design of cold chamber shot end, incorporating an *intensifier*, assures top-quality, dense castings. Shot plunger speed, after its initial slow, forward movement, can be adjusted to attain any speed up to 500 f.p.m. At any predetermined plunger position, the shot intensifier can be activated to generate plunger pressures up to 20,000 p.s.i. Intensifier pressure is also adjustable. Throughout, the new Model 800 is *Cleveland-engineered* to give you highest casting quality with utmost reliability of machine performance. Call in a Cleveland sales engineer, or write direct, for machine specifications.

Remember, Clevelands Cut Costs!

For more information circle No. 25 on the Reader Service Card

THE CLEVELAND AUTOMATIC MACHINE COMPANY

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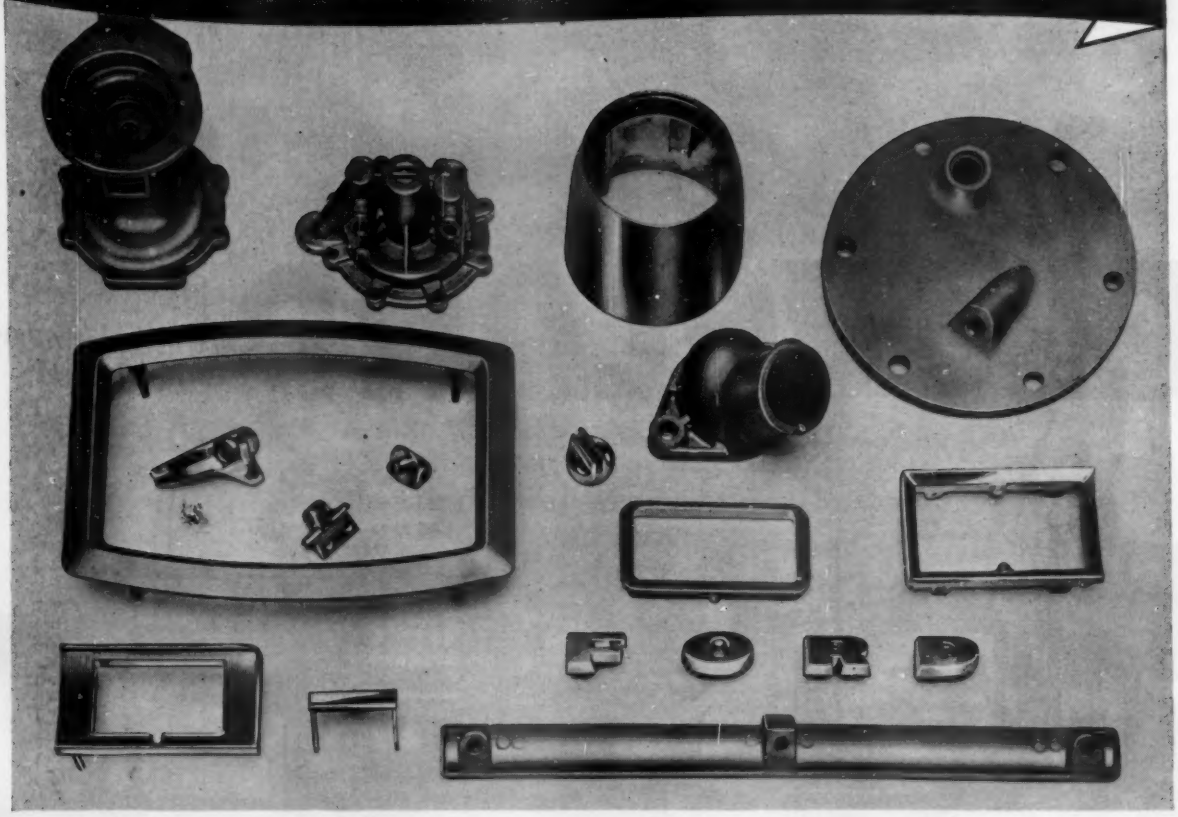
Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

AUTOMOTIVE PARTS (Original and Replacement)



Die-cast by DOLLIN

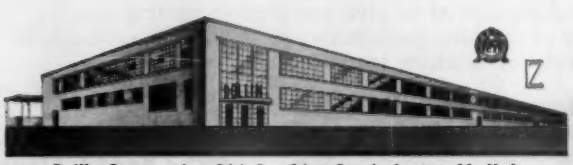
to rigid quality – volume – price requirements

Shown above are typical automotive parts from our current production, for current models . . . all die-cast at high-speed and low cost on Dollin's specialized equipment . . . delivered with strict adherence to high-volume schedules.

For manufacturers in every field, DOLLIN renders a complete die-casting service on mass-production runs of large or small zinc and aluminum die-castings—from design and engineering co-operation, to delivery of finished parts ready for assembly.

DOLLIN methods and equipment assure die-castings that are sound in structure, smooth in surface finish, accurate in dimensions. Available with cast inserts of all descriptions. Machined as required, in any desired mechanical, plated, painted or lacquered finish.

For cost-cutting suggestions, quotations and engineering advice, submit drawings or samples of your parts, without obligation.



Dollin Corporation 614 So. 21st St., Irvington 11, N. J.

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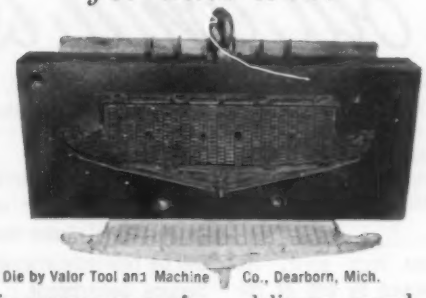
DOLLIN Zinc & Aluminum DIE-CASTINGS

For more information circle No. 33 on the Reader Service Card

ultrasonically inspected CSM 2 DIE CASTING DIE STEEL

for auto trim

Like so many other automotive trim and hardware dies, Crucible CSM 2 was selected from warehouse stock for this long-run grill die. Built from a prehardened 25″ x 15″ bar, it produced 341,598 parts during the model year, and is now used for replacement parts.



Die by Valor Tool and Machine Co., Dearborn, Mich.

Like all Crucible die steels, it was ultrasonically inspected. This assures you of sound die steel quality — every time. It's a big reason why CSM 2 . . . and its partner for aluminum die casting, NU DIE V . . . are so popular that they're stocked in more than 430 sizes in Crucible warehouses from coast to coast. These sizes range from 1″ to 40″ wide . . . ¾″ to 15″ thick — and can be cut to your specifications at the warehouse.

For your die steel requirements — for holder blocks, solid dies, inserts or sleeves — you'll get *fast* delivery, sound quality from your local Crucible warehouse. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

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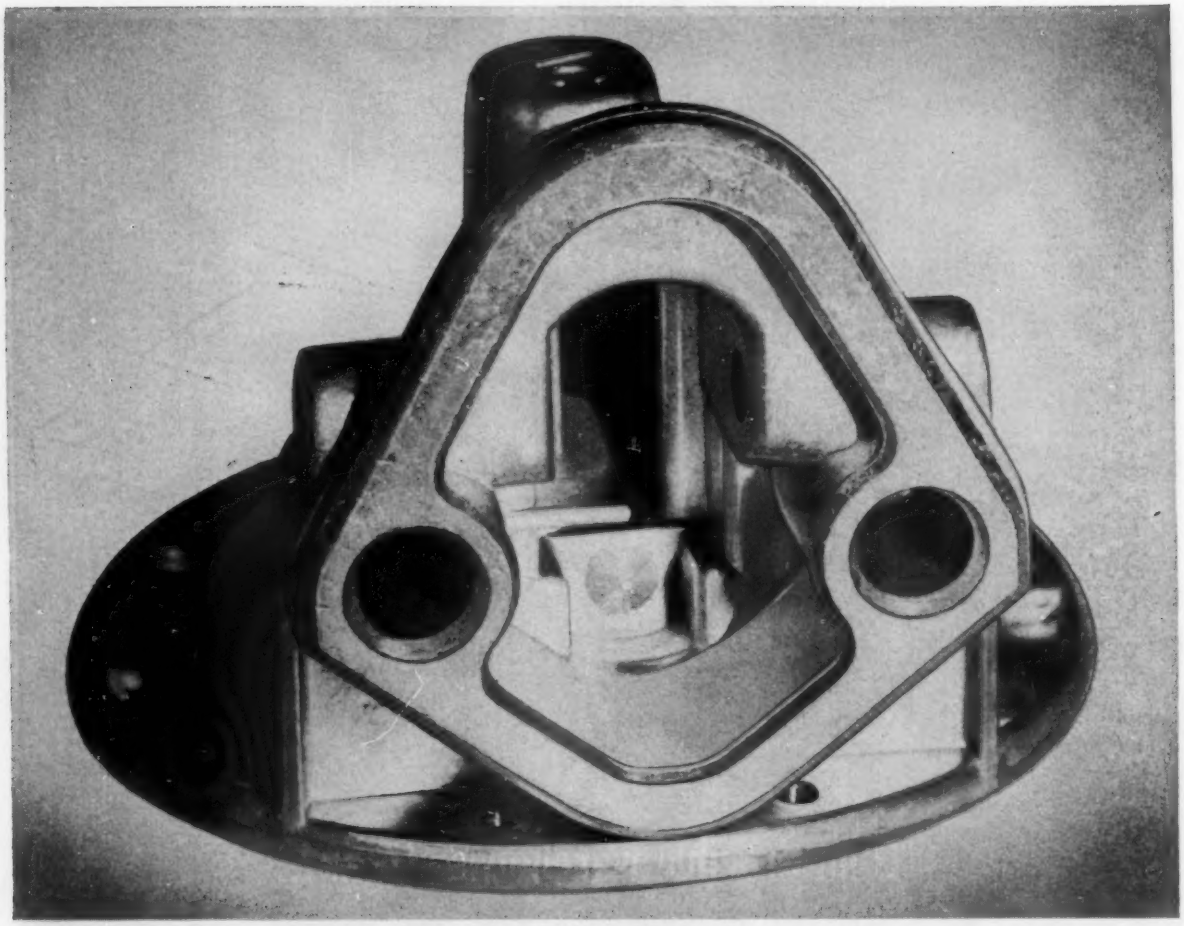

DIE-CAST WITH TADANAC ZINC...

"but what is it?"

The die-casting industry of today is producing more and more complicated shapes, never before thought to be possible. Our illustration is typical of such shapes . . . using Tadanac Zinc of course, because it's ideal for low temperature high speed operation, and has the essential tensile strength and freedom from corrosion.

Tadanac Brand's consistent high purity, its guaranteed supply position backed by one of the world's largest zinc producers and a prompt delivery service, make it a preferred brand by die casters.

If you require any information or assistance regarding your Zinc die-casting operations, write to our Metal Sales Division, where your inquiries will be promptly attended to by our Technical Sales Service Department.

The photo shows part of an Automobile Fuel Pump Casing

COMINCO

THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED

METAL SALES DIVISION: 215 ST. JAMES ST., WEST, MONTREAL, QUEBEC, CANADA

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TADANAC ZINC SHAPES THE THINGS TO COME

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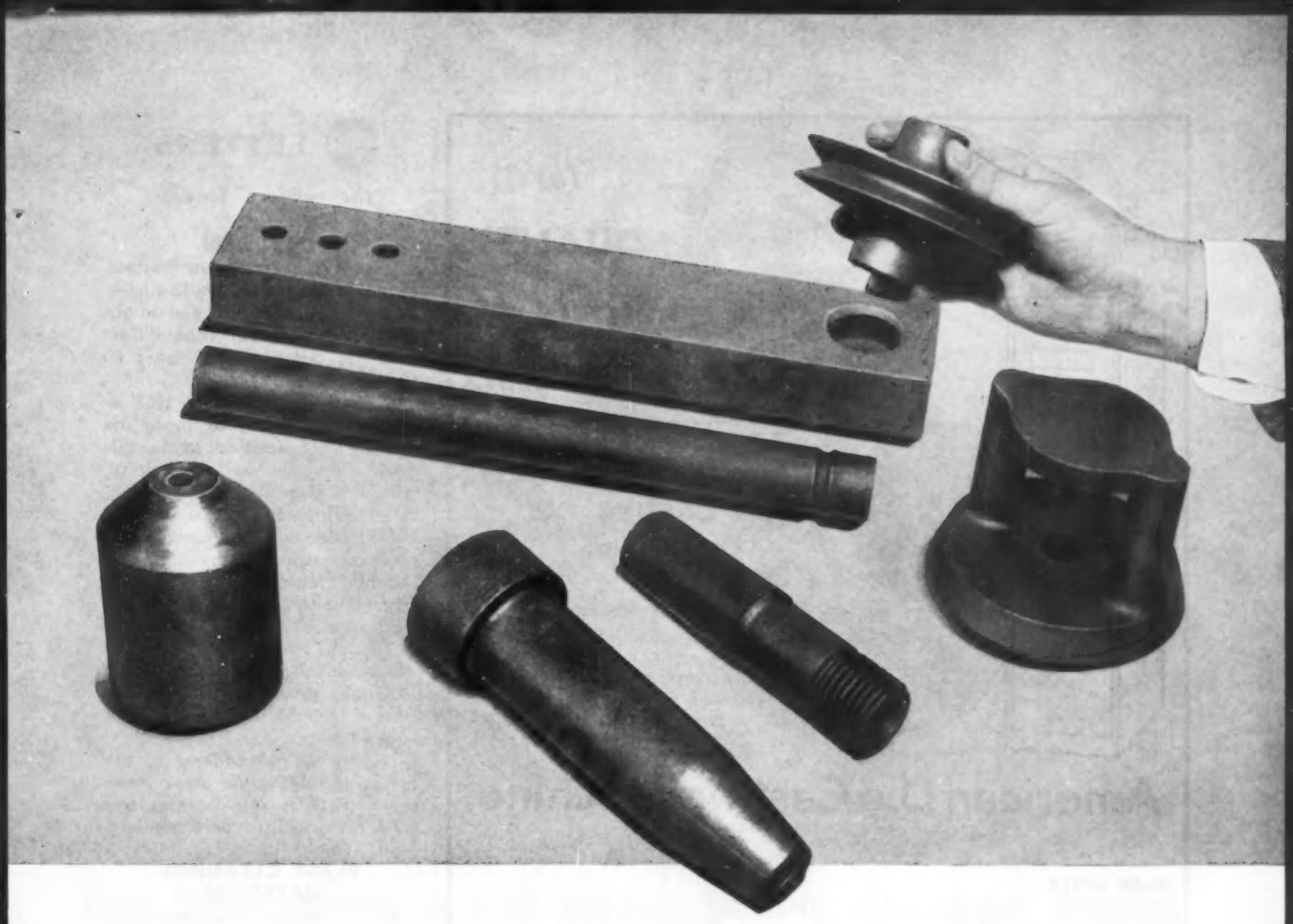

Molten aluminum can't wet these parts

All these parts and fittings for aluminum die-casting and direct-chill casting are made of REFRAX® silicon-nitride-bonded silicon carbide. All are precisely formed. Yet molten aluminum can't wet them, can't harm them. That alone recommends REFRAX parts and shapes for aluminum holding furnaces and aluminum alloying furnaces (including reverberatory and induction). They are Carborundum's answer to the need for a material that can be formed into intricate parts with outstanding corrosion resistance far above normal melting temperatures.

Consider the value of these other properties in your operation: Tolerances of ±.0005 in./in.; a modulus of rupture of 5600 psi at 2450°F (even the best heat-resistant alloy melts below this temperature); and high heat conductivity that approaches that of chrome-nickel steel. Mail the coupon today for complete information.

CARBORUNDUM

Registered Trade Mark

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***GET HELP** on your problem . . . write for these 3 booklets:*

MAIL THIS COUPON TODAY

Refractories Division
The Carborundum Company, Perth Amboy, N. J., Dept. W117

Please send me:

- ☐ Current issue of Refractories magazine on REFRAX
- ☐ Reprint of article in Product Engineering, Feb. '57 entitled "Nitride-bonded silicon-carbide bridges gap between metals and ceramics".
- ☐ Bulletin on REFRAX

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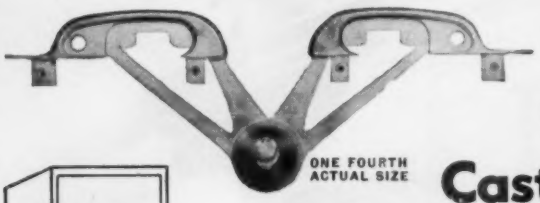
Company_____

Street_____

City_____ **Zone**_____ **State**_____



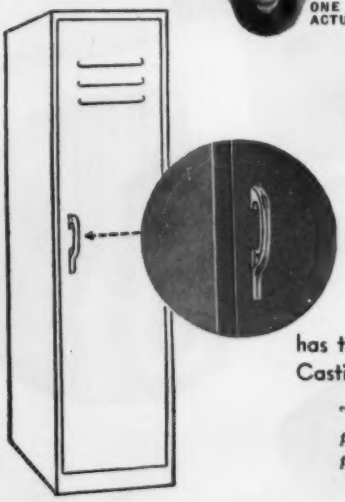
ONE FOURTH ACTUAL SIZE

for

QUALITY

Castings at

MASS PRODUCTION COSTS



HELFRICH

DIE CASTING CO.

North Canton, Ohio

RUSSELL P. HELFRICH, Owner

has this to say about the two American Die Casting Machines installed in his factory:

"Outperformed other machines used in previous years with more than twice the production, at lower operating cost."

American Die Casting Machine

Model 60HYD

Delivered Complete— READY-TO-RUN — NOTHING ELSE TO BUY!

OVER 1300 Free Cycles Per Hour —— Shot Capacity Up To **3 Lbs.**

Speed up your PRODUCTION . . . Increase your PROFITS!

*Since putting 2 Americans into production 2 years ago, Helfrich Die Casting Co., report they are now producing more and better castings per hour than ever before.

Now you too, can run high grade castings, up to 3 lbs., at high speeds and low operating costs. Actual tests operating 8 hours a day, 5 days a week, show total cost of gas and electricity of ONLY 17c PER HOUR!

Outstanding features include — all steel welded construction — automatic electric cycling at high speed—17⅛" die platens—4½" die stroke—highest grade controls and valves mounted for easy maintenance and accessibility — a complete package with self contained unit.

Available in Air or Hydraulically operated plunger gooseneck type for zinc, tin or lead, or, cold chamber type for aluminum, brass and magnesium.

COMPONENTS

(Standard Equipment)

- **VICKERS** Hydraulic System
- **NORTH AMERICAN** Blower
- **SQUARE-D** Electrical Controls
- **ATC** Timers
- **MARVEL** Synclinal Filters
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Write for Free illustrated folder containing complete data on all models.

AMERICAN DIE CASTING MACHINERY CO.

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PMM LETTERS

the readers' forum

CAST DIES

With reference to your September, 1957 issue, we would appreciate any information you might have available concerning "Cast Dies" as described on pages 60 and 61.

A copy of the March, 1956 issue or the names of those die makers now licensed to do this work would also be very helpful. —W.L.R. Eng. Dept.

In your September, 1957 issue of PMM (page 60) item Cast Dies—you make reference to casting in Ceramic Molds. I would very much like to have a copy of this item, which appeared in PMM for March, 1956.

I would also like to be placed on your regular mailing list to receive PMM. — R.A.J., Chief Tool Engineer.

The name and address of the company holding the Shaw Process Patents in this country has been furnished to both readers. —Ed.

BLAST CLEANING MATERIALS

We are interested in locating a source for ground walnut shells which could be used as a blast cleaner for dies or parts. Do you know of such a source? If so, would you let us know who it is. —W.H.P. design engineer.

Two possible sources for this material have been furnished.—Ed.

SHELL MOLDING

In a recent issue of your magazine, I read an article on Shell Molding. I am extremely interested in this phase of work and am anticipating a small shop to accommodate this type of work. I would appreciate any literature available on this process giving equipment, bonding of sand, metals used, etc.

I shall look forward to hearing from you in the near future about this. — R.E.S.

Sources of general information regarding the shell mold casting process have been furnished.—Ed.

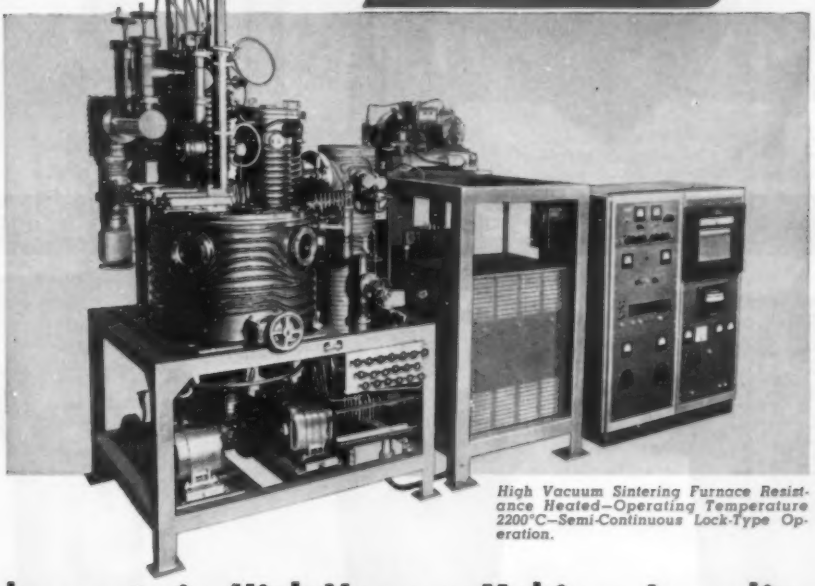
GLOSSARY

"In an article published in the July issue of PRECISION METAL MOLDING, entitled the Glossary of Barrel Finishing Terms, it was stated that the original glos-

Continued on page 68

VACUUM FURNACES

by Kinney®



High Vacuum Sintering Furnace Resistance Heated—Operating Temperature 2200°C—Semi-Continuous Lock-Type Operation.

New Developments in High Vacuum Melting, Annealing, Brazing, Welding, Sintering, Stream Degassing and Heat Treating • • •

NEW HIGH TEMPERATURES
VACUUM • NEW HIGH VOLUME

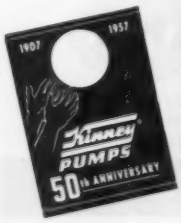
KINNEY engineering has taken a giant step, breaking through old limitations, to bring you High Vacuum Furnaces tailored to your needs—regardless of the metals with which you work. Their advanced design accents three advantages: 1—Low first cost and low operating cost; 2—Versatility to embrace a broad range of operations; 3—Important economies in time and power consumption.

KINNEY High Frequency or Resistance Heated Sintering Furnaces enable you to work at 2200°C . . . Clean Vacuum . . . No Carbon! Pumping Systems are designed for *high, clean* Vacuum; frequently employing Fractionating Diffusion Pumps and Cold Traps. Special Pumping Systems are available for materials with high outgassing rates. Units can be modified for Sintering in inert atmosphere.

KINNEY Furnaces and Heat Treating Chambers, now in service, are setting outstanding performance records in the production of high purity Titanium, Germanium, Zirconium, Uranium, Tantalum, Beryllium, Silicon, Molybdenum and rare earth metals, as well as Stainless Steel, High Alloy Steel and the more common metals.

From laboratory and pilot plant to full scale production, the Vacuum "Know-How" of KINNEY engineers is a definite plus factor for you. Write for full information on the KINNEY High Vacuum Furnace to update your facilities.

SEE US AT BOOTH 1459



WRITE—
FOR YOUR COPY OF THE PROGRESS REPORT TO THE METALS INDUSTRY DESCRIBING KINNEY VACUUM FURNACES

KINNEY MFG. DIVISION
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Please send me copy of your latest Bulletin describing new developments in Kinney High Vacuum Furnaces.

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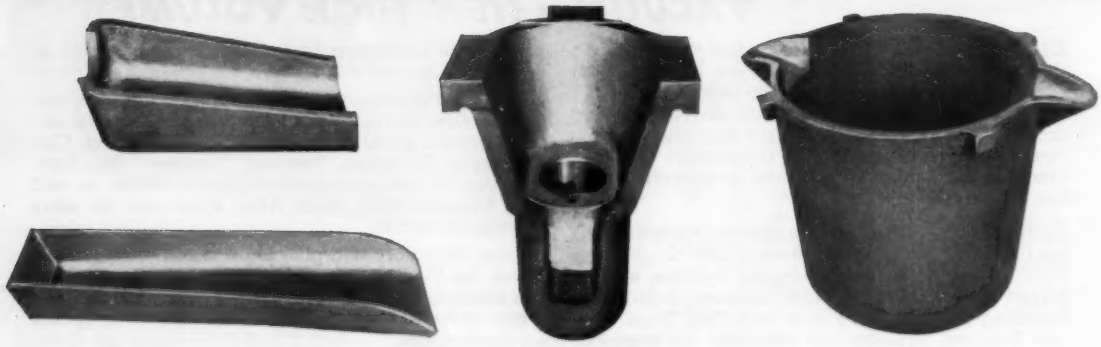
NOW...A FULL LINE

OF DODGE CUSTOM-MADE

STEEL PARTS AND ACCESSORIES



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DODGE STEEL COMPANY

Finished Products Division

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THE MOST IMPORTANT ALLOY IN A STEEL CASTING IS QUALITY

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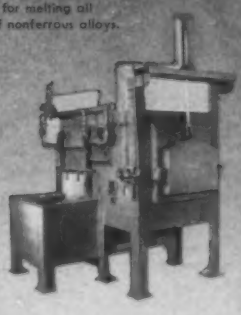
Few melting cost factors are more important than

THE FIT OF THE FURNACE

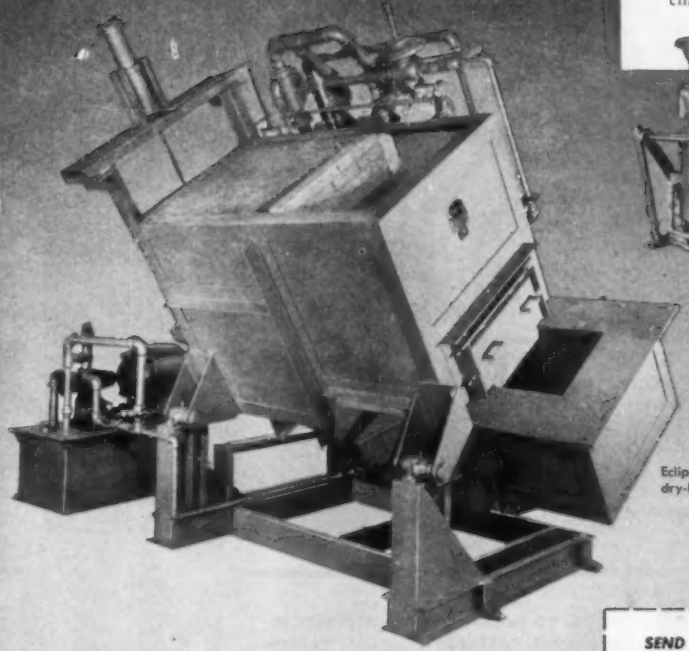
Eclipse top-firing type double chamber dry-hearth furnace

Our experience proves that the *fit* of the melting furnace — the way its design features mesh with the rest of your operation — is a *major* factor in the size of your net profit. That's why efficient Eclipse crucible and double chamber dry-hearth furnaces are offered *in such a wide variety of firing, loading, pouring, and dipout arrangements.* And each furnace is available in *a range of sizes bracketing practically all logical users* of any given type. In short, you easily select the Eclipse furnace you need for your plant arrangement, space requirements, personnel, production rate, etc., just as if you had designed it yourself! How closely have you considered this approach to cost-cutting? Discuss your furnace *fitting* problem with the highly experienced Eclipse representative . . . especially if your operation has grown or changed in recent years.

Eclipse hydraulic tilting nose-pour crucible furnace for melting all types of nonferrous alloys.



Eclipse side-firing double chamber dry-hearth furnace



Eclipse hydraulic-tilting double chamber dry-hearth furnace

Eclipse®

INDUSTRIAL FURNACE DIVISION

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1018 Buchanan Street, Rockford, Illinois
ECLIPSE FUEL ENGINEERING CO. OF CANADA, LTD.
20 Upjohn Road, Don Mills, Ontario

SEND new Bulletin C, illustrating and describing 9 Eclipse crucible and double chamber dry-hearth furnaces that offer custom-design efficiency for most metal-melting operations.

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COMPANY_____

STREET_____

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For more information circle No. 38 on the Reader Service Card

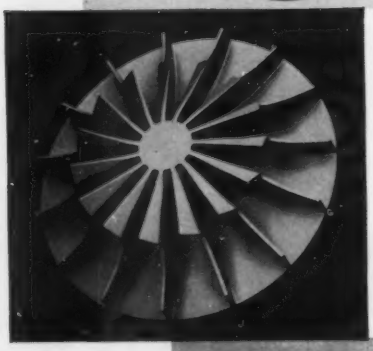
The Royal Family of INVESTMENT CASTINGS

FROZEN MERCURY

Yes, there is a difference in investment casting QUALITY! Although some of the variants are not immediately detectable by visual inspection, they *are* there and they *are important!* Many of the nation's industrial leaders have selected Alloy Precision Castings — producer of "The Royal Family" of investment castings — as their primary source. Here are some of the reasons why:

- **ALLOY PRECISION** is the nation's only foundry with both FROZEN MERCURY and LOST WAX facilities under one roof!
- **ALLOY PRECISION** produces the industry's GREATEST SIZE RANGE (1/10th ounce to 100 lbs.) and choice of alloys.
- **ALLOY PRECISION'S** metallurgists, foundry engineers, laboratory technicians CONTROL every step of production.
- **ALLOY PRECISION'S** complete inspection facilities include the newest X-RAY, MAGNAFLUX and ZYGLO equipment.
- **ALLOY PRECISION** enjoys an enviable reputation for demonstrated foundry skill, consistent HIGH QUALITY and deliveries made promptly on schedule!

The Alloy Precision trademark (APC) on a casting is the royal stamp of approval. Guarantee the success of your investment cast parts! Send them to ALLOY PRECISION CASTINGS CO.



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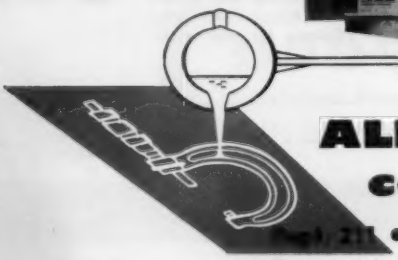

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"Our Di-Profiler paid for itself in less than 3 months"... says Admiral Die Castings, Chicago

THE Di-Profiler
RECIPROCATING HAND MACHINE

Illustration shows diamond file reciprocated by the Di-Profiler operating at 75 strokes per second, with stroke length of 3/16". Tool is finishing detail on ejection half of die for upper guard of portable electric saw.

for time-saving, precision die making and maintenance

Use the Di-Profiler for die shapes like these

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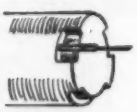

SHOULDERS AND RECESSES

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CORNERS, SMALL AREAS, GROOVES, FINE DETAILS

In the die shop of Admiral Die Castings, Chicago, (division of Portable Electric Tools, Inc.) and in scores of other die shops, the Di-Profiler has paid for its moderate cost many times over in man hours saved and in increased accuracy of castings.

For die making and die maintenance—for all draw filing operations, cavities, core pins and those hard-to-reach details—the Di-Profiler is indispensable.

The Di-Profiler is driven by a flexible shaft; it is light, sturdy, free from vibration. The reciprocating speed, controlled by foot rheostat, is variable from 0 to 100 strokes per second; the stroke length is adjustable from 0 to 1/4".

Di-Profiler accessories for every contour

... Diamond and Swiss files, flat and riffle; hones and T-C scrapers; also, for use with the Di-Profiler rotary hand piece: diamond wheels, points and T-C burrs.

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In making these small valve wedges

Inco investment casting eliminates 5 machining steps...cuts costs 30%

Originally William Powell Company made these small wedges from Monel* nickel-copper alloy bar stock . . . using six separate machining steps.

But costs from labor and machining time ran high. Powell engineers figured that casting these Monel wedges would cut expensive machining steps. But could this wedge design be cast close enough to final specifications? They brought their problem to the Inco Foundry.

Inco recommended investment casting. Showed Powell how a few non-functional design changes made the Monel wedge ideal for production lot quantities.

Powell gave the go-ahead. Results with Inco investment casting . . . only one machining step is still required. And Powell's production cost for the Monel wedge is down better than 30%.

How can Inco investment casting cut your production costs?

If your product contains metal parts that are 6x5 inches or smaller, weigh under 3 lbs., require starting tolerances of plus or minus 0.005 inch per linear inch, and need 5 or more fabricating steps, look into Inco investment casting. You can often obtain the part with little or no machining and at a substantially lower cost.

Send us a sample or blueprint. Our Engineering Department will be glad to submit their recommendations and quotations on Inco investment castings. *Registered trademark

5 Advantages of Inco Investment Castings

- Save up to 60% of production costs.
- Longer life with harder alloys.
- Little or no machining required.
- Wider design latitude.
- Higher alloys at lower cost.

"Cast to outlast"

This helpful 16-page booklet is filled with illustrated case histories. Some of them may suggest practical answers to your small parts cost problems. Write Inco for your copy.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK

INCO-CAST PRODUCTS

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for the most complete line of

POWDER METAL PRESSES

FROM 10 TONS TO 500 TONS • DIE FILLS UP TO 15"
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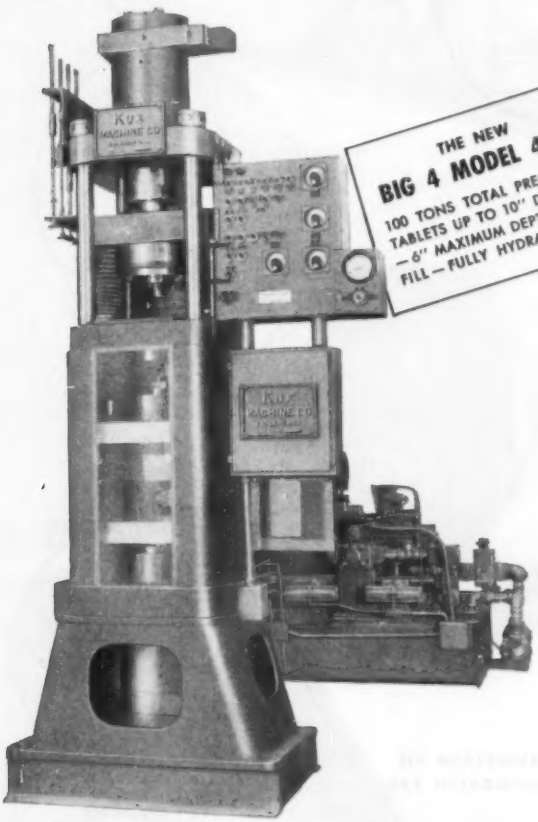
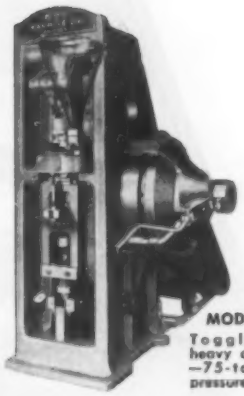
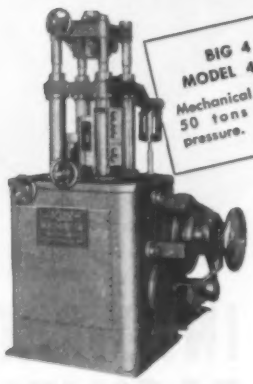
An entire range of sizes and models, both mechanically and hydraulically operated is available in the Kux family of powder metal presses, a few of which are illustrated. A card will bring you an illustrated catalog of these famous machines which set the standards for peak performance.



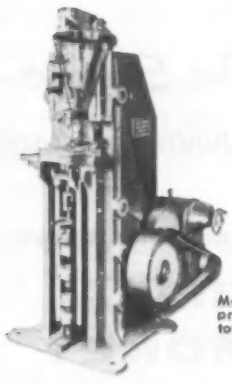
- **Fully Hydraulic**—applies pressure to tablet with both upper and lower punches. Lower punch ejects tablet with full forming pressure.
- **Completely Automatic**—pushbuttons operate machine continuously or through a single cycle with an automatic stop position.
- **Accurate Dimensional Thickness of Tablets**—upper and lower punches come to a positive mechanical stop position, holding thickness of each tablet.
- **Always True Density**—upper and lower punches can be adjusted to come to a hydraulic pressure stop position, applying exact pressure on the tablet to give true density regardless of variation in die fill.
- **Perfect Punch and Die Alignment**—combination leader-pin, ball-bearing guides keep upper punch in perfect alignment with die at all times, so that close tolerance parts can accurately be made.
- **Push Button Control of Adjustments**—for upper punch penetration into die, and the die fill allows instant and accurate change of either setting, and scales show the exact position of the punches at all times.
- **Independent Secondary Lower Punch Mechanism Available**—hydraulically operated with separate timing and stroke control—can be used to apply pressure, to eject compact, or to move core rod up and down during filling or ejection sequence.



MODEL 65B
Toggle type heavy duty press—75-ton total pressure.



BIG 4 MODEL 450B
Mechanical press 50 tons total pressure.



MODEL 64
Multiple motion press—30 tons total pressure.

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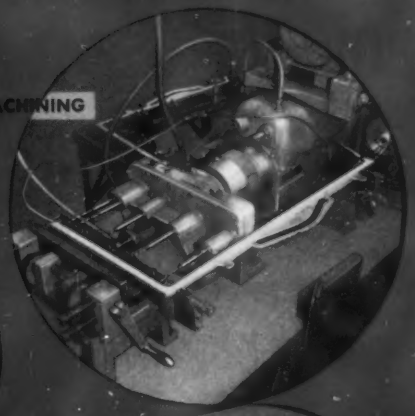
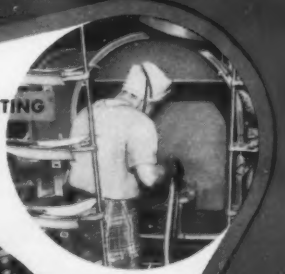
DIE CASTING NEWS





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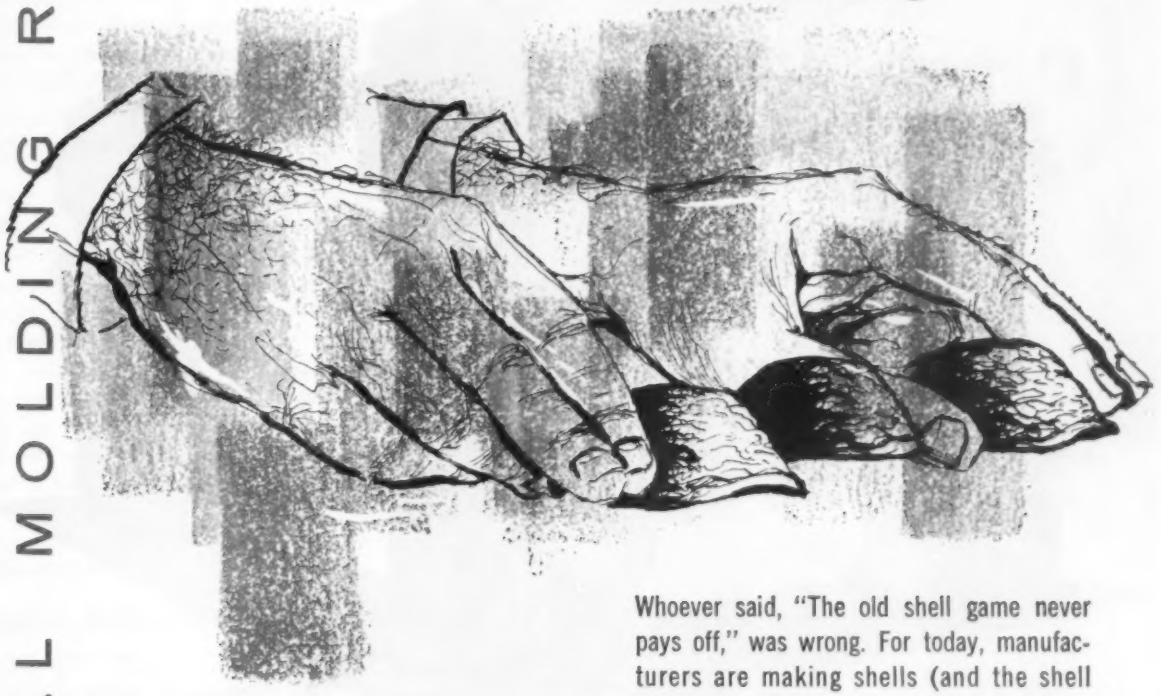
PLENCO SHELL MOLDING RESINS

Careful consideration of the shell can be most rewarding



Whoever said, "The old shell game never pays off," was wrong. For today, manufacturers are making shells (and the shell molding method) pay handsome rewards in the production of molded parts. We refer, especially, to those companies who rely on Plenco phenolic molding resins.

Exactly what are the rewards? The answer is simple: lower production costs.

For example, the elimination of considerable machining and finishing. The higher yield from metal. The reduction in percentage of rejects and increased production speed.

There are rewards in shell molding with Plenco phenolic resins. Consider it carefully. Consult with Plenco.

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FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin

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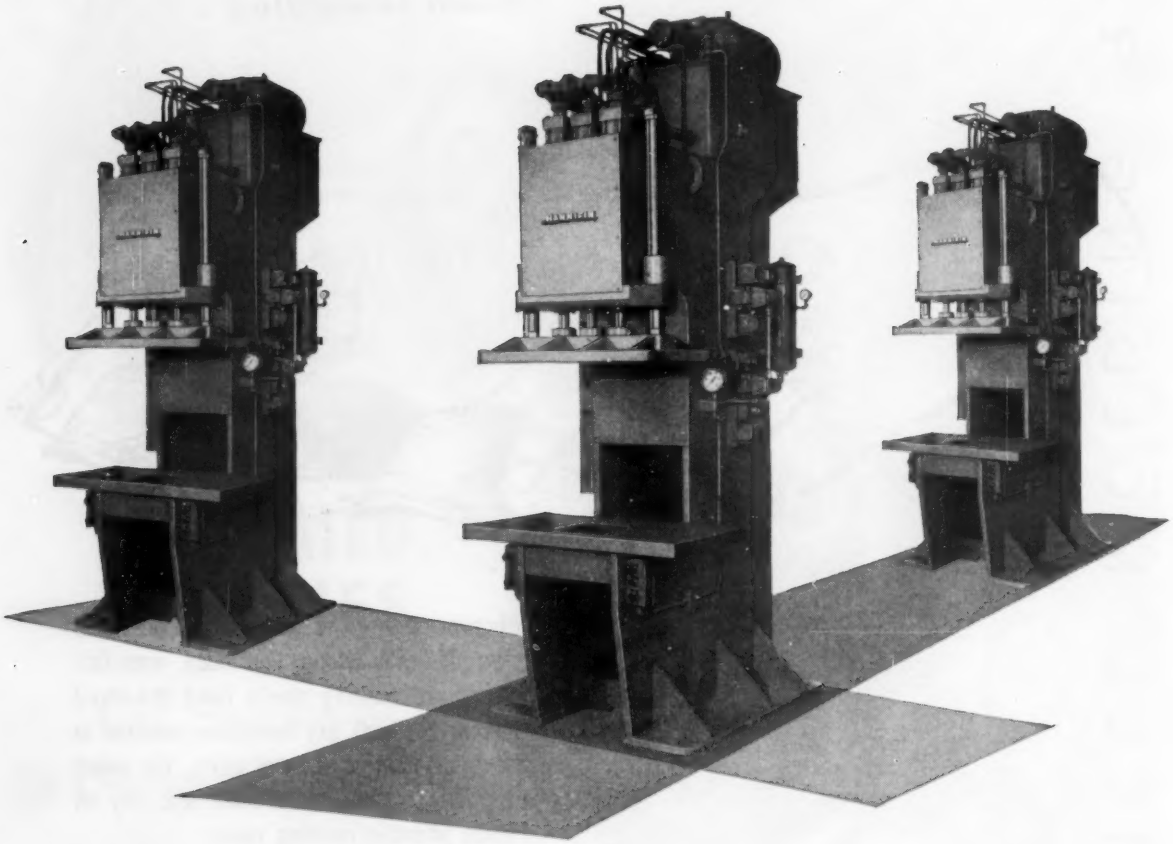
Why they trim more castings per hour with Hannifin hydraulics



Die casters who use Hannifin hydraulic Trimming Presses can quickly show you why their production rates are up.

The reason—Hannifin hydraulic Trimming Presses are different. They are specifically designed to take advantage of the desirable characteristics of hydraulic operation, yet fast enough to out-perform mechanical presses.

The really big advantage is the increased flexibility with Hannifin hydraulic power. You can have maximum rated power at any point in the stroke. That means shorter setup time, because it's so easy to adjust the press to trim at the exact point required by the die.

Hannifin presses give operators plenty of room for loading and unloading—with no sacrifice in speed and with the safety of dual controls. Operator fatigue is less because of the smoother, quieter action. Also, the smoother action of a Hannifin hydraulic press produces cleaner trims and reduces deburring and polishing time.

We believe it will pay you to investigate the advantages of Hannifin hydraulic Trimming Presses.

HYDRAULIC

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PRESSES

Hannifin offers a complete line of hydraulic presses, including special and "modified standard" models of great speed for specialized applications like trimming. For complete information, write Hannifin Corporation, 581 So. Wolf Rd., Des Plaines, Illinois.

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DIE CASTERS GET GOOD RESULTS WITH Cr-Mo-V (HIGH V)

In shop after shop, die casters are agreed that, whether working with lead, aluminum or magnesium, die casting can be performed economically with Cr-Mo-V (High V)—Bethlehem's 5 pct chrome-moly tool steel, containing 1 pct vanadium.

Cr-Mo-V (High V) promotes economy, and makes possible long production runs, because it resists wash and erosion. Moreover, it has the stamina to stay on the job for long periods, prior to the development of a fine network pattern of heat-checking.

Cr-Mo-V (High V) is uniformly annealed, to permit ease of machining. It has center density and grain refinement, and is also free from porosity. With this grade, there is little chance of cleavage cracking, assuming that adequate radii are used in the die, and the steel is properly heat-treated.

Uniform Hardness to Rockwell C 45-47

Cr-Mo-V (High V) is a uniformly deep-hardening steel, with minimum size change and warpage. Even in massive sections it can be heat-treated to a uniform hardness of Rockwell C 45-47.

Besides, it's made by a controlled melting procedure, and its quality is checked by means of ultrasonic testing.

If you'd like to undertake a trial run with Cr-Mo-V (High V), all you need do is call your Bethlehem tool steel distributor.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

This die of Bethlehem Cr-Mo-V (High V) was used in producing a popular make of aluminum fry pan.

BETHLEHEM STEEL

BETHLEHEM TOOL STEELS

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OILITE POWDER METAL COMPONENT DOES "TRIPLE DUTY" IN POWER MOWER

Another cost-saving application of Amplex Powder Metallurgy

How to make a self-propelled rotary mower more compact and still permit the rotary blade to operate while the mower idled—*without increasing costs!* That was the problem company engineers tackled. One way was to combine three components—over-running clutch, oil pump piston cam, differential—into one. They experimented widely with designs and materials. Result: an OILITE powdered bronze worm gear with one side of the hub a cam operating the oil pump, the other side a wheel drive ratchet. (The other half of the ratchet—fixed to the drive shaft— OILITE powdered iron.) The design achieved the desired compactness and idling characteristics. OILITE powder metallurgy achieved a *major reduction* in cost, an *increase* in serviceability.

Do you have a design problem? Maybe Amplex has the answer. Write for detailed information about Amplex powder metal components—OILITE Bearings, Parts, Filters. Or call your nearest engineering representative listed in the yellow pages under "Bearings—OILITE."

A CHRYSLER OILITE PRODUCT

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ALNICO MAGNETS cover a wide variety of applications: for aircraft electric motors, compass needles, denture inserts, hearing aids, toy train magnets and many instrument applications. Finishing costs for them all are kept down by the Accumet precision investment casting process at Crucible.

accurate dimensions *of these Crucible investment castings* lower finishing costs

Because the castings in the picture are Alnico magnets, their finishing usually calls for costly grinding operations. That's because Alnico materials are hard and brittle. These castings, however, need virtually no finishing at all. The reason is to be found in the type of casting: Crucible Accumet® precision investment casting.

Crucible uses hot molds with special inner linings for producing Accumet precision investment castings which give two advantages: (1) they turn out castings to close tolerances, and (2) they produce surfaces that are exceptionally fine. These two advantages virtually eliminate all finishing operations. Crucible precision investment castings are available in a complete range of stainless, tool, and alloy steels, as well as Alnico permanent magnets.

For detailed information, write for booklet on "Crucible Accumet Investment Castings". Or you can find out exactly what type of castings you need by calling your Crucible representative.

Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

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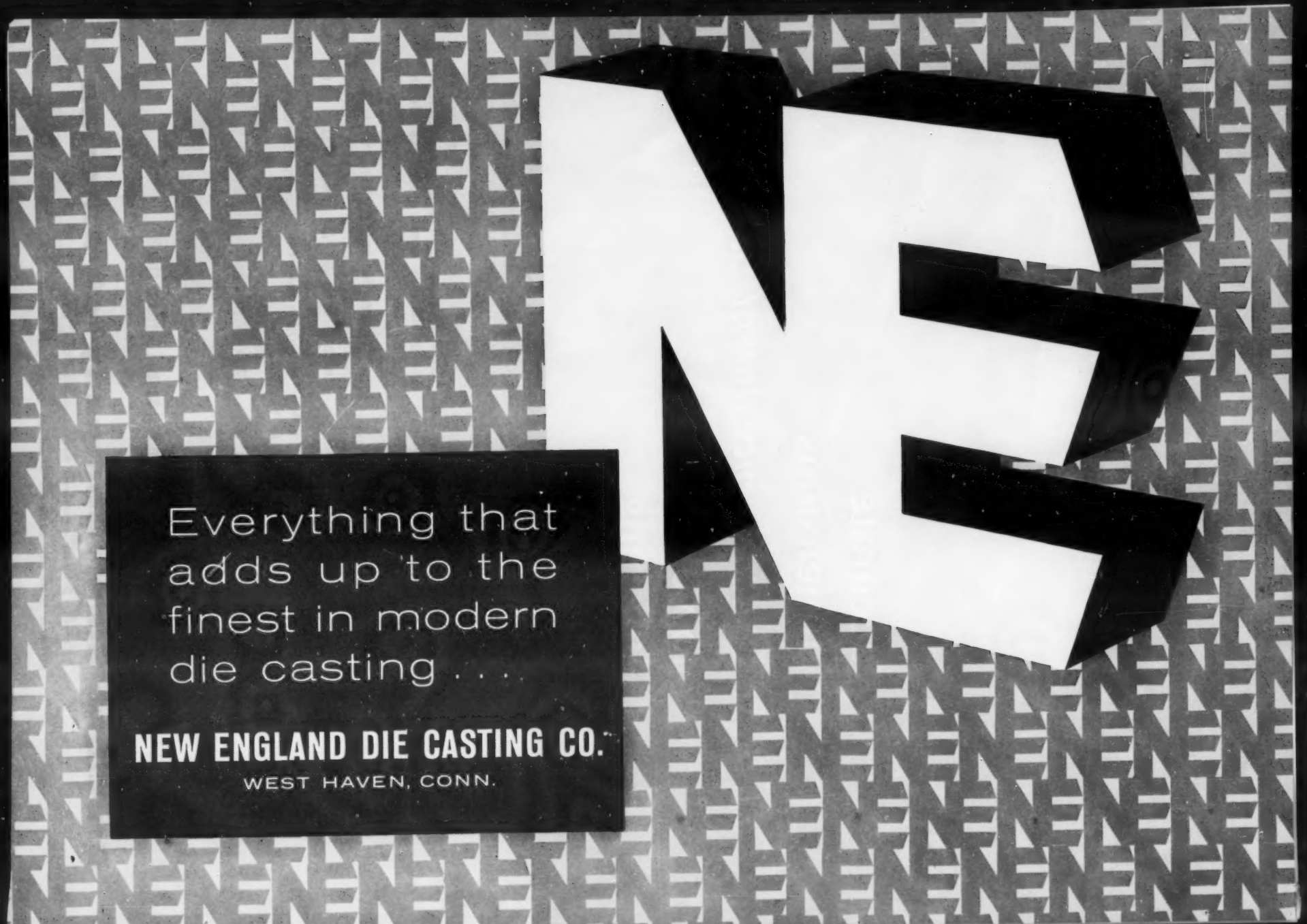
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Everything that adds up to the finest in modern die casting . . .
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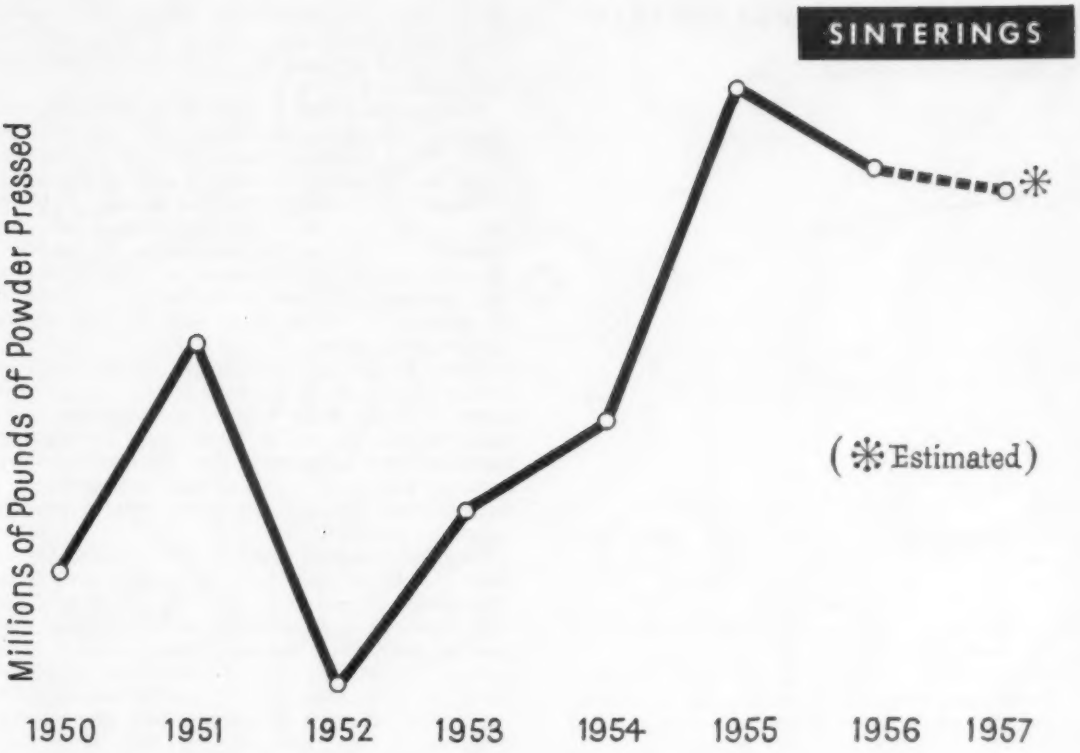

Forecast of Powder Metallurgy Industry

UNFORTUNATELY, over the years the custom fabricator of sinterings has wedded himself to two major industries — automotive and household appliances. While there are innumerabale applications outside of these two major consumers, there can be no question but that over 50% of the output of the powder metallurgy industry goes into these two limited channels and stays there.

Any forecast, therefore, particularly a short-term forecast, must take into account the outlook in the automotive and household appliance fields. Based upon the probable production in these two consumer markets, the powder metallurgy industry can look for a marked decrease in the volume of this business in 1958.

There are, however, some aspects of the automotive industry that will help to hold up production in spite of an expected decrease in the number of units produced. A higher percentage of the passenger automobiles will have automatic transmissions, power steering and power assisted brakes. These three "extras" all utilize a number of sinterings. Every indication points to an automobile production of not more than 6,000,000 units. In other words, the total anticipated maximum will be approximately equal to, or slightly below, the production in 1957.

In the appliance industry the picture is considerably darker. By the end of 1957 the market for four major appliances will be approaching saturation. Refrigerators will show better than 95 percent market saturation so that only small replacements and the small number going to new family units will represent the output. This will leave the household refrigerator business with productive capacity above that needed to supply the market.

In the washing machine industry the market will be approximately 90% saturated, and in the vacuum cleaner industry almost 70% saturation will be reached.

Continued on next page

MARKET SATURATION
HOUSEHOLD APPLIANCES — 1956

Refrigerators	**96%**
Washing Machines	**87**
Vacuum Cleaners	**67**
Television Sets	**81**
Home Freezers	**18**
Clothes Dryers	**12**
Air Conditioners	**8**

POWDERED METALLURGY FORECAST

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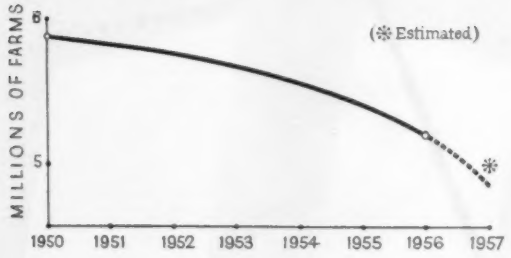


Radio and television, unless colored television surges ahead more rapidly than anticipated, will reach approximately 80% of market saturation.

That leaves, therefore, home freezers, clothes driers and air conditioners in the major appliance field as the only likely prospects for growth. And even in these fields the picture is not bright. Until a change is made in refrigerator design to eliminate the freezer unit, there is little chance that the freezer market will grow at any appreciable rate. Clothes driers may be expected to show a continued rapid gain, but these units do not utilize sinterings to any great extent.

Of the three major appliances that can use a number of sinterings, the air conditioning market shows the lowest percentage of saturation, under 10%. Unfortunately, for the past two years, individual room air conditioners have not moved at anywhere near the rate that the manufacturers have anticipated. Now, at the end of the 1957 selling season, two of the major producers of room air conditioners had approximately a quarter of a million units in storage that will have to carry over to the 1958 season. This unhealthy condition has resulted in the announcement by two manufacturers that they are going out of the appliance business. One of them has said it will try to find additional manufacturing lines in entirely new products so as to maintain corporate entity and continue in business. The other one has not yet announced whether it will attempt to continue in business or not, but it is certain that both of these companies can no longer be a factor in the appliance business.

It is, therefore, apparent that the two major markets for sinterings in 1958 may be smaller than in any previous year. The custom fabricator of sinterings must develop entirely new markets if they are not to experience a very marked recession in business. From where these new markets will come is still questionable. The agricultural implement and machinery industry which has been a consistent consumer of sinterings shows no sign of a great increase in production. The day of the relatively small independent farmer is rapidly passing so that the manufacturer of tools and implements for the farm must change from a mass production industry to the production of large specialized units in relatively small quantities. It is probable then that in this field there may also be a decrease in the consumption of sinterings, though in all probability it will not be either as marked or as rapid as in the case of automobiles and appliances.

Over the years there has been far too much complacency among the producers of powdered metal parts. These producers have sat back and, for the most part, waited for business to come to them. Now it behooves the industry to start selling . . . and this selling must be done at the design level. It will no longer be possible for the salesman to be essentially an order taker. He will have to learn to sell not only his company's product but he must sell the use of sinterings in places where they have never been contemplated before.

Today the powder metallurgy industry is faced with a job of education greater than any it has ever faced. Because of its relative newness and difference, the use of powder metal parts intrigued the designers. This is no longer true. Powder metallurgy is today just another fabricating technique and as such it must compete with every other fabricating technique available.

Two big untapped markets still remain. One of these which has been noted time after time is the substitution of sinterings for small gray iron castings on which a considerable amount of machining must be done. The other one is the utilization of sinterings for highly stressed parts that heretofore could not be considered. This market must of necessity depend on the development of new iron powders, probably of the prealloyed, low alloy type. From such a powder, sinterings having tensile strengths in excess of 75,000 or 80,000 psi without the necessity of multiple pressing and sintering, and without the necessity of infiltration with copper or brass can be made. Powders that will fill this bill are already on the horizon, but in order to open this market, they must be sold for little more than pure iron powder. This will probably mean in the price range of 15 to 20 or 25 cents per pound.

Given these new low alloy powders that will heat treat without either infiltration, carburizing or other second operations, or given aggressive selling, or both, it will be possible for the powder metallurgy industry to continue its present rapid rate of growth. Without these it is probable that the next year will see a marked decline in the output of the industry.

The past several months has seen the adaptation of powder metallurgy to several items where its use was never previously contemplated.

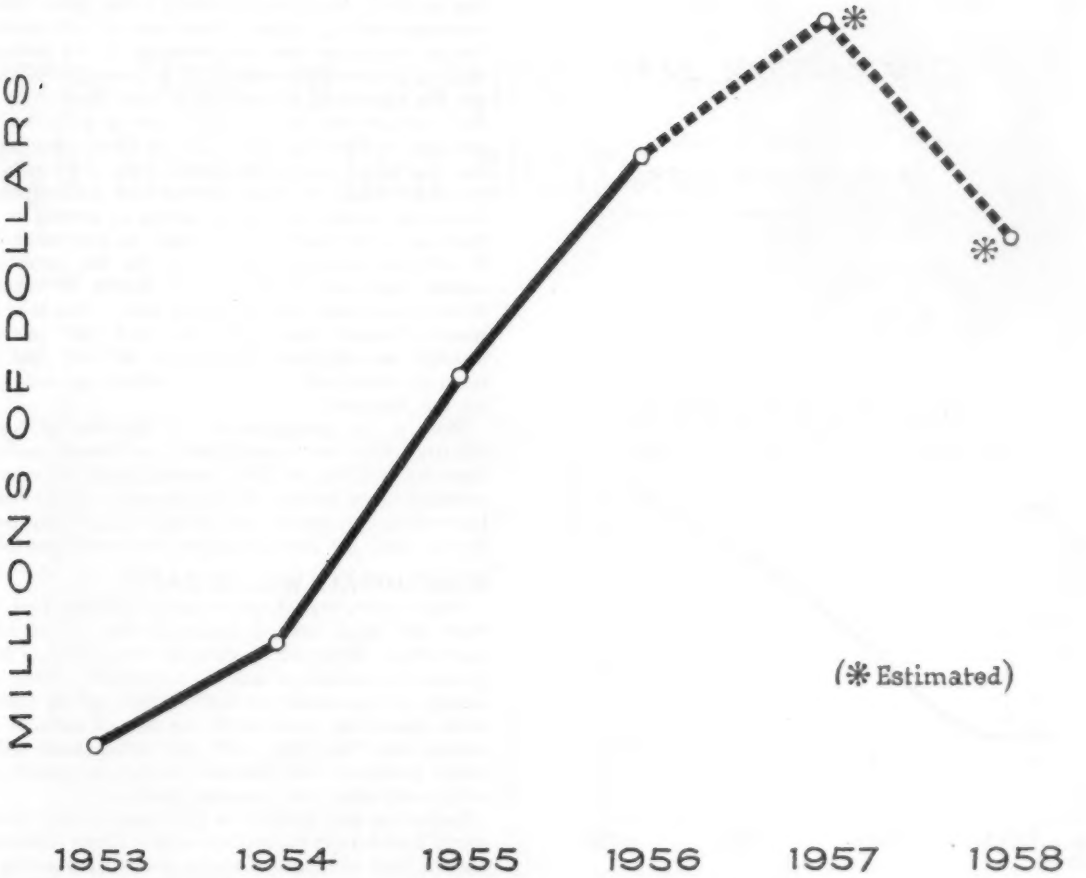
This has brought gears, cams, and several types of bearings into the field. Their users are extremely satisfied with the performance of these parts.

One of the most outstanding characteristics of the newly designed parts is their low cost. Machining, assembly, and grinding to close tolerances has been eliminated in many cases.

Thus the new salesmen needed to put this fabricating technique across have many selling points already outlined for them. In a sense, they will have to be advisors, consultants, and sales engineers, working with the engineers and designers who are always looking for a less expensive way to produce an article.

What does this mean?

It means that if the powder metallurgy industry is to rise instead of descend in the next twelve months, its salesmen will have to sell, and sell, and sell!



PROGRESS OF INVESTMENT casting manufacture is seen in this chart showing production figures from 1953 to 1956, and moving into the future to predict a 10% drop in production for the coming year's business.

Forecast For Investment Casting

IN spite of the recent curtailment in military purchases and in spite of the shift in emphasis from manned aircraft to missiles, the prospect for the investment casting industry in 1958 is encouraging.

Most companies, it is true, will suffer. These are the ones who are wholly or almost wholly tied into military procurement. For them the outlook for at least the first half of 1958 does not look good. But by the second half of 1958 the advanced missile program should be moving well enough so that military purchases will again be very appreciable. For those companies who have either completely divorced themselves, or largely divorced themselves, from the military uses of investment casting, there is every reason to believe that there will be an increase of 10% or 15%. Some producers, particularly those who do no military casting, are confidently looking forward to an increase of approximately 20% in 1958.

How widespread the improvement in business will be, will depend upon the sales effort that is expended to develop new markets. It will depend upon the investment casting industry becoming more highly mechanized so that the relatively great amount of handwork that is presently necessary can be either eliminated or greatly minimized. And it will also depend upon the investment casting industry de-

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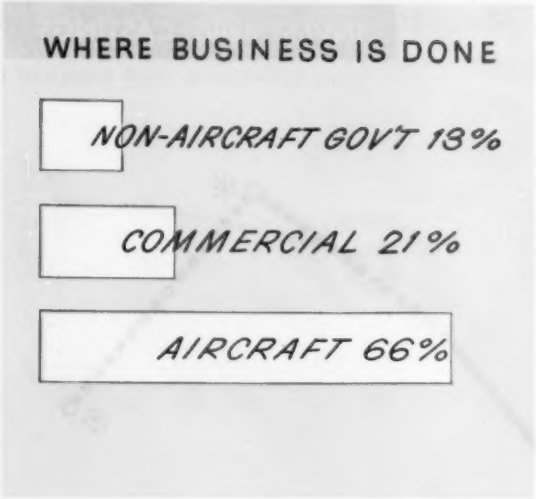
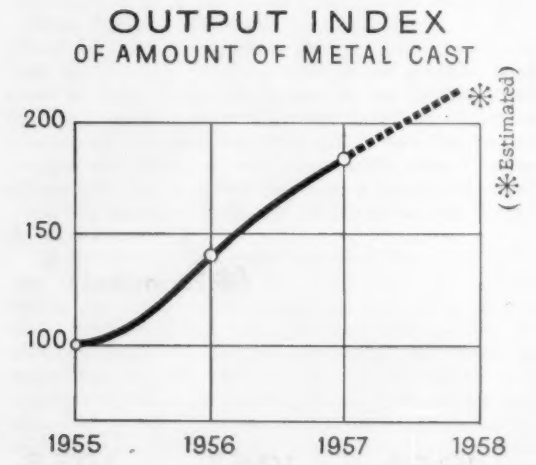
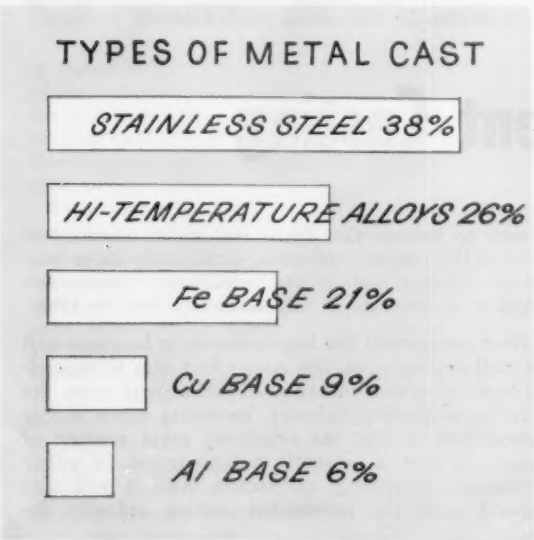






INVESTMENT FORECAST

continued from preceding page

veloping some new techniques so that larger castings can be made.

In the field of increased sales effort, emphasis must be placed upon selling at the design level. In spite of the publicity that is continually being given the investment casting industry, there are still all too many design engineers who are unaware of the potentialities of investment castings. In a design they do not see the possibility of combining two, three, four and five components into a single casting with the consequent tremendous reduction in both manufacturing and assembling costs. Based upon their past experience, many of these design men look upon investment casting only as a means of getting a part that cannot be made economically in any other way. It will be necessary, therefore, for the investment casting salesmen to find some means of reaching these design men and educating them. This is not an insurmountable task, and provided the salesman himself has adequate knowledge, he will find that in most cases such educational efforts are welcomed by the designer.

Most of the producers in the investment casting industry who were questioned concerning probable business activity in 1958 contemplated an ever increasing labor market. If this increase in the cost of labor develops, and it very likely will, it only points to the need for mechanization wherever possible.

WHAT METALS WILL BE CAST?

Most producers of investment castings feel that there will be a marked decline in the use of cobalt base alloys. However, there is no unanimity as to increases in metals or alloys. Apparently those producers who are most strongly entrenched in military work expect an increase in the use of vacuum cast metals and the high strength nickel base alloys. Other producers feel that the non-ferrous metals and alloys will show the greatest gains.

Users are also divided in their predictions. Choice seems based upon experience with a slight preference toward high alloy and stainless steels. Any swing toward these alloys will be dictated by the much wider selection of castable alloys available among the ferrous-base metals.

WHAT PATTERN MATERIALS WILL BE USED?

Here again, the opinions of producers of investment castings varies considerably. Those foundries which are anticipating mostly long run jobs and small piece-size jobs expect to use more plastic patterns at the expense of wax. Others, particularly those who have done mostly military work and must now go after commercial accounts expect to use mostly wax. This is to be expected since these concerns will secure the short run jobs and the larger piece-size parts. In both of these cases wax patterns are preferable from a strictly economic viewpoint.

WILL THERE BE MUCH PLANT EXPANSION?

For the time being, at least, plant expansion will slow down very materially. Increased output will come through more efficient utilization of existing plant space, much of it as a by-product of mechanization. All of the producers who furnished any information on this point seemed to be in agreement that the industry is, at present, considerably over-expanded as far as manufacturing space is concerned.

DIE CASTINGS

These are the many characteristics of . . .

Parts Made of Selected High Strength Cast steels

By ROBERT J. ELY*

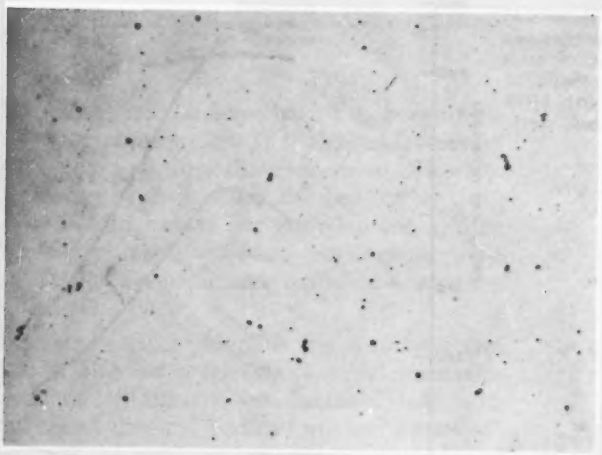
1. TEST bar used for the detailed evaluation of many types of high strength cast steels.

Editor's Note: While the change from manned aircraft to missiles may lessen the demand for investment castings in the high strength range, the data collected regarding steels that fall in this class can be utilized by the foundryman in his bid for commercial and industrial business. Because these castable steels are readily available, many highly stressed machine parts that have previously been designed as forgings or machined wrought parts can now be investment cast. The properties given in the following paper should be of major interest to engineers who are faced with the problem of designing highly stressed parts. If space requirements, weight, machining costs or tooling costs are a problem, then investment cast parts in one of the high strength steels may be the most logical answer.

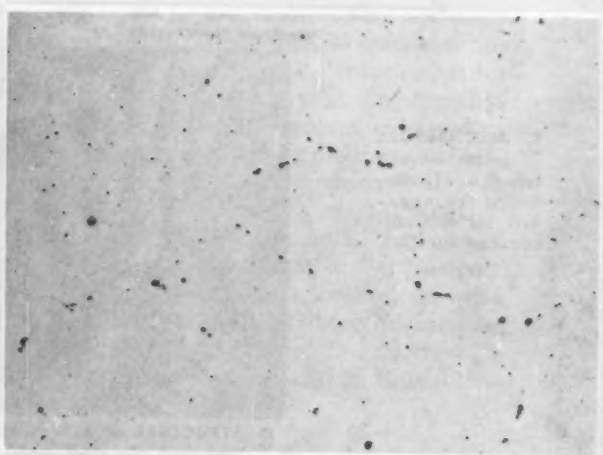
This paper was originally presented at the spring, 1957, meeting of the Investment Casting Institute.

IN considering aircraft and missile work we must continually recognize the weight limitations which are imposed. If efficiency of design and performance are the sole criteria, we are immediately faced with some simple comparisons with the light alloys if we wish to sell steel as an alternate material. Forgetting for a moment temperatures in excess of 300° F to 400° F, the simple facts of the strength-weight ratio

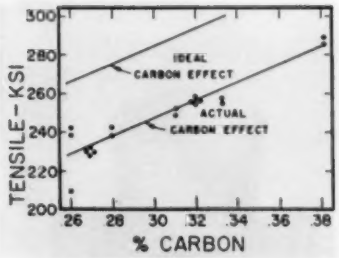
*Assistant Chief Metallurgist
American Brake Shoe Company
Mahwah, N. J.



2. Random inclusion distribution obtained using CaMnSi deoxidation is illustrated in this micro-photograph.



3. GRAIN boundary inclusion distribution obtained with Zr bearing deoxidant can be seen clearly in this micro-photograph.



4. COMPARISON of ideal, measured carbon effects on tensile strength.

concept mean that the steel part must be available and producible in the 180,000 psi bracket or higher.

The problem then can be stated somewhat as follows: Over and above the 180,000 psi tensile level, what properties do we measure and on what sort of cast shape do we make these measurements?

The second half of this question is more easily answered so it will be dealt with first. We begin with the much maligned test bar. It is becoming stylish to say that "Test bars don't fly," and "Let's forget the test bar. Let's test the casting." This is fine in its place and cannot be underestimated as a control and inspection method when specific parts are being considered. But the basic problem of evaluating and understanding materials can only be solved by working with the soundest and most reproducible test bars which we can devise. Only when we approach this condition can we understand and appreciate the ultimate potential and true behavior of the alloys. The translation of the ultimate potential of the alloy to a functional casting is no less important, but must be recognized as a separate problem and dealt with accordingly.

As far as answering the ques-

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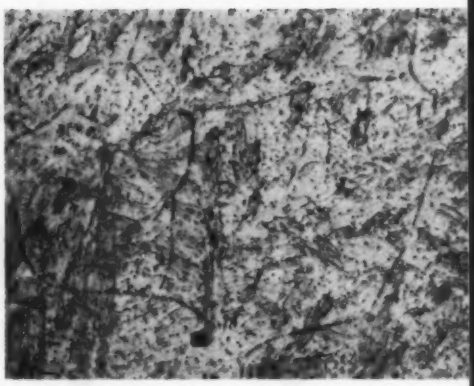
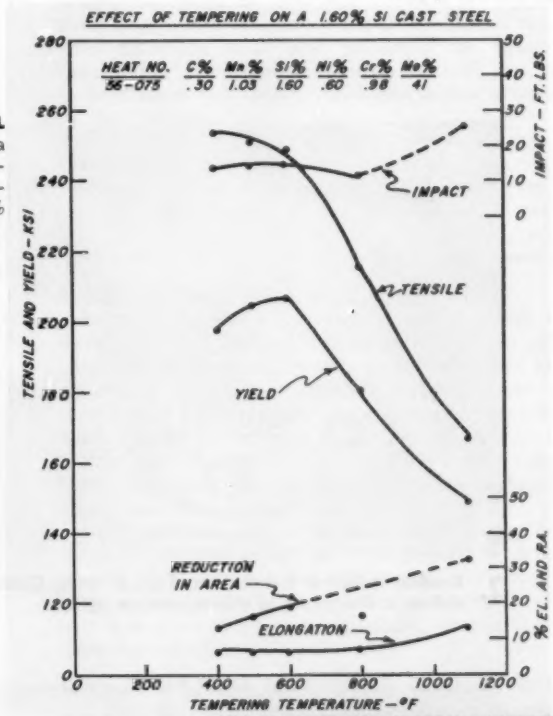
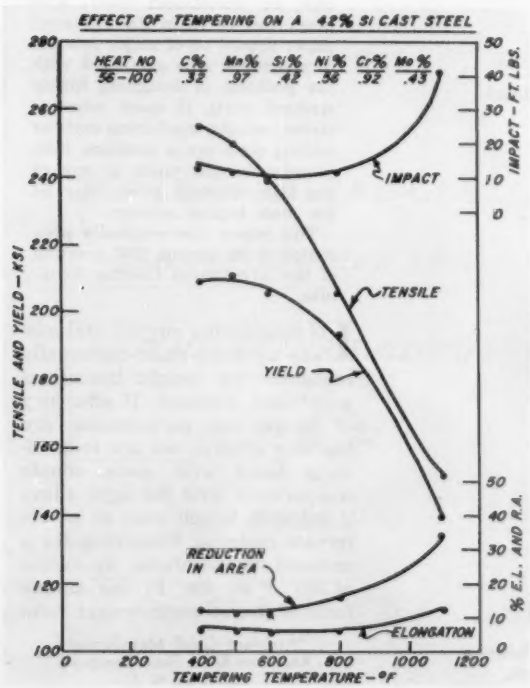


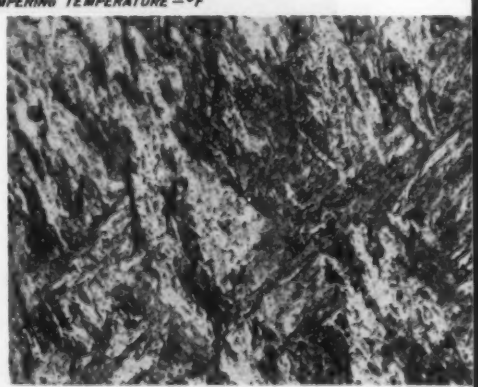
7. STRUCTURE of an air-quenched, tempered die steel after homogenization at 1850°F.



6. MECHANICAL properties as a function of tempering temperatures for 1.06% silicon cast steel.



5. MECHANICAL properties as a function of tempering temperature for 42% silicon cast steel.



8. STRUCTURE of air-quenched, tempered die steel after homogenization at a temperature of 2280°F.

If you apply heat to aluminum LINDBERG can show you the better way

Lindberg-Fisher electric resistance melting and holding furnace with Lindberg Autoladle automatic pump.

Heat and aluminum have been Lindberg's twin babies for many years. If the manufacture of your product requires the application of heat to aluminum anywhere along the line we can help you do the job better. For years our engineering and research staff has been creating improved methods and developing more efficient equipment in this field.

Most recent development is the Autoladle (we call it "Little Joe"), the first practical automatic aluminum ladling unit yet devised. Used with Lindberg melting and holding furnaces "Little Joe" (shown at the right) makes automatic casting of aluminum fast, dependable and economical.

Lindberg's Melting Furnace Division makes a wide variety of melting and holding furnaces for aluminum, brass, bronze, tin, zinc, lead and other non-ferrous metals. These include aluminum induction, nose-pouring crucibles, electric resistance holding furnaces and big reverbs. For foundry, permanent mold or die-casting plant, independent or captive, there are Lindberg melting and holding furnaces to fit your requirements. If your problem in this field needs a special solution Lindberg's design staff can find it. Just get in touch with the Lindberg plant or the Lindberg Field Representative in your locality, or write Lindberg-Fisher Division, Lindberg Engineering Company, 2450 West Hubbard St., Chicago 12, Illinois. Los Angeles Plant: 11937 S. Regentview Ave., at Downey, California.

LINDBERG heat for industry

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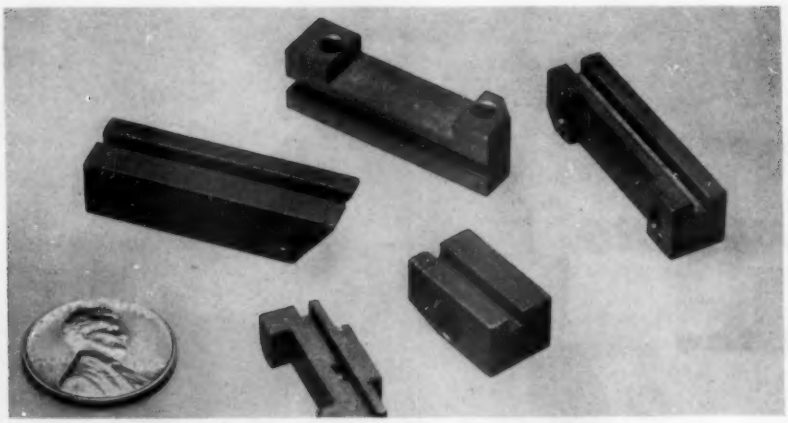


1. INSTRUMENT PARTS of very high accuracy made of powdered iron. The accuracy is reflected in higher than average costs.

Extreme Precision Is Possible . . .

but only at higher than average costs.

BY NATHAN H. SANDERSON, III*

WHAT are the criteria by which a measuring instrument is judged?

First is the initial, or built in, accuracy.

Second is the retentive accuracy: how long does the instrument maintain its original precision.

Third is the freedom from wear, especially wear of vital parts.

Fourth is the cost and frequency of repair and adjustment.

Fifth is the first cost. This is probably the least important.

Measuring instruments are designed for, and must withstand, many years of continual service. The maker can employ the best possible materials and workmanship even though it increases the cost. The buyer, knowing that he will amortize the cost over many years, can afford to spend more at first. Experience has shown that paying a little more at first means a far longer, trouble-free, low-maintenance service life. These policies guide the B. C. Ames Co.

One of the critical parts of dial gauges is the guide block which prevents turning of the toothed rack. The slighest rotation of this rack could introduce frictional forces that would destroy the accuracy of the instrument. Further, reproducibility of readings would be impossible if the rack turns and excessive wear on the delicate components will inevitably result.

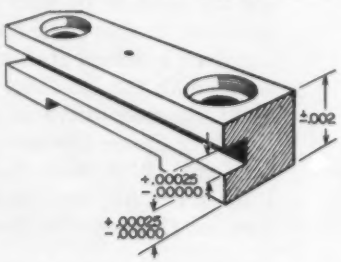
A group of these guide blocks is shown in figure 1. They are made of powdered iron; pressed, sintered, coined and oil impregnated. They represent one of the most exacting jobs being done today by powder metallurgical methods. Both Sintered Metals, Inc. and Keystone Carbon Co. make them in the five sizes and styles illustrated.

What makes these blocks so noteworthy: Remember they are sinterings. The answer is simple, dimensional accuracy. Three critical dimensions must be held much closer than is usual in normal commercial practice, *and the cost of the blocks is correspondingly higher.* The sketch, figure 2, shows which are the critical dimensions.

In spite of the part's extra cost, there is still a 70 percent saving in manufacturing costs, because most machining operations have been eliminated. The old way to make the blocks (and it's still used to make them over 1¼ inches long) was to cut the bars from stock, mill to shape, grind the base, and finally broach the slot, all expensive operations. Now the sintered blocks are delivered ready to use after drilling and counterboring for the mounting screws.

There has been no appreciable decrease in the inspection load. Experience with sinterings has shown that in lots of from 5,000 to 10,000 pieces statistical methods of inspection are adequate. This means that only 10 percent of the lot must be inspected, no change from established practices for machined parts.

Because the sintered blocks are most economically made in fairly large quantities per run, stocking and inventorying are slightly more costly than before. Also, the sinterings are slightly more difficult to machine than wrought steel parts, there is so little machining this is of slight concern.



2. TOLERANCES as shown are achieved by high precision tooling and by coining.

*Purchasing Agent
B. C. Ames Co.

Here's the ideal combination for casting aluminum automatically

Lindberg-Fisher two-chamber Induction Furnace for melting and holding equipped with Lindberg Autoladle.

Do you die-cast aluminum? Then take Lindberg's famous two-chamber induction melting and holding furnace, add "Little Joe" Lindberg's new automatic pump, and you'll have the most efficient automatic combination anywhere. The Lindberg-Fisher two-chamber furnace *melts* in one chamber, *holds* metal at precisely the right temperature in the other chamber, and "Little Joe" automatically delivers exactly the right size shot to the casting machine. With this combination all handling of molten metal is eliminated, perfect control of metal temperatures and shot size is maintained, and all automatically. For safer, more economical, more precise handling of aluminum or any non-ferrous metals or alloys better see Lindberg. Just get in touch with the Lindberg plant or the Lindberg Field Representative in your locality, or write Lindberg-Fisher Division, Lindberg Engineering Company, 2450 West Hubbard St., Chicago 12, Illinois. Los Angeles Plant: 11937 S. Regentview Ave., at Downey, California.

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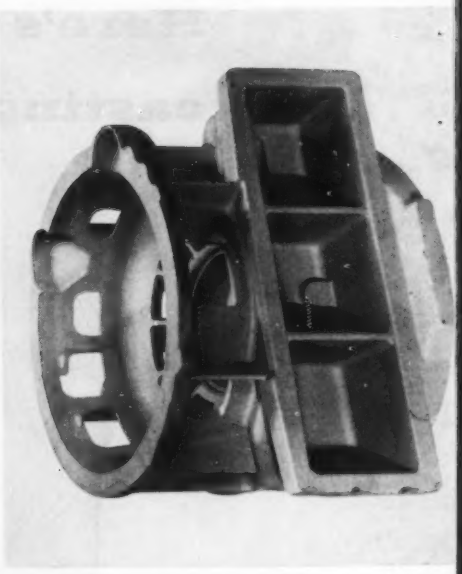
PERMANENT MOLD CASTINGS

How this firm solved production problems in...

Casting Big Engine Parts



HOUSING is an aluminum casting made in a permanent mold for use by a division of an automotive company. Close tolerances are necessary to cut costs of finishing. Only a precision casting process can produce them efficiently.

EVERY company, at one time or another, solves a difficult problem. Centr-O-Cast and Engineering Co. of Detroit, Michigan, finished the sixty-five pound housing seen at the right for a major automotive company. It was completed and, according to company records, delivered ahead of schedule, but not without hurdling some major obstacles. The fact that these obstacles were overcome is evidence of the progress and vitality of the precision casting industries and shows that permanent mold castings are dependable for industrial engine applications. The details of this problem and its solution follow.

PROBLEM: A manufacturer of industrial engines used in the automotive industries needed a cast aluminum housing to be used on a double hydraulic converter. The piece, as its designers and engineers had planned it, would weigh almost 70 pounds.

It was of extremely intricate and complicated design and several things were involved, including cast-in hydraulic lines and a cast-in hydraulic sump together with many apertures. All these were to be held to close tolerances when finished. Here is how this was accomplished at the Detroit firm.

METHOD: Various, differing casting methods were tried, tested and discarded. At first, even the sand casting process was explored. The main reason for this was that it was known to be economical.

But as far as the cast aluminum housing was concerned, sand castings were not economical. Their quality was poor and tolerances were not being held in the process.

Permanent mold promised to give the needed accuracy and fulfill the tolerance specifications. It was tested.

Permanent Mold Gives Best Results

Finally the firm's staff hit upon the application of a permanent mold casting with the top and half of the inside formed by dry sand. This was the technique which was worked out in detail to produce an unusual type of casting once believed "too difficult" to cast.

SOLUTION: The mold used to cast the part has a permanent portion which is a unique assembly. Instead of being a single mold, it is composed of a series of five, individually separate shoes which from the exterior of the housing. Because all of the shoes are hydraulically operated, it is possible to cycle the mold in the most efficient and proper manner.

A heavy riser was used for the casting. It came through a heavy, dry, sand core. There are three separate pouring sprues on the sump's flanges. Centr-O-Cast's staff used a cover-core and were able to feed the heavy hydraulic passages which are specified "Air Tight". The cover-core allowed them to preserve the exact dimensional accuracy of the casting being made in the permanent mold.

Only a minimum of machining is necessary on all faces. The casting is under heavy strain when in use. This made the staff anxious to get the wall thick enough. But the finished permanent mold casting proved that the original 3/16" wall was strong enought. It stood up under the tests made to determine its maximum strength before production began.

RESULTS: The housing cast in the semi-permanent mold was favorably received by the customer. Use of the process produced a casting that is held to extremely close tolerances.

The soundness of the casting is impressive through its structure. The casting's apertures and flanges are highly accurate.

Lower parts of the piece are very thick, however inspection showed that they are sound.

The cost figure for the casting's production is *excellent*.

When aluminum needs heat treating it's time to look to LINDBERG

Lindberg Cyclone batch type furnace for heat treating aluminum castings.

When your use of aluminum makes it essential to apply heat for annealing or stress relief Lindberg can come up with the right equipment to do the job. Whatever the requirement our long experience in the application of heat to all types of metal can provide you with just the right furnace to fill your specific need. Maybe the batch type furnace shown here is what you need, or a big bottom quench for treating large aluminum sheets. No matter, Lindberg's staff of engineers, metallurgists and research technicians will face up to your problem. They'll help you find the answer, too, with the right type of equipment to treat aluminum or aluminum alloys to exact requirements of your product. Just get in touch with the Lindberg plant or the Lindberg Field Representative in your locality. Lindberg Engineering Company, 2450 West Hubbard St., Chicago 12, Illinois. Los Angeles Plant: 11937 S. Regentview Ave., at Downey, California.

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heat for industry

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DIE CASTINGS

These two instruments are proof that...

In Either Rain or Shine Die Castings Do the Job

by Ralph Chappell*

ONE of the latest devices to hit the bonanza do-it-yourself market is a pair of meteorological instruments, one an anemometer and the other a wind

1. ANEMOMETER for air speed.

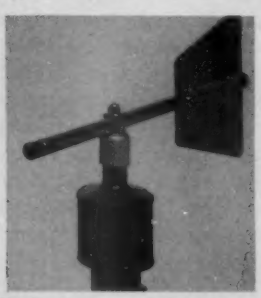
direction indicator. Normally, precision instruments to do this job are very high priced. To aid the amateur meteorologist and to supplement the well-known thermometer, barometer, and hygrometer, the two new low-priced instruments have been introduced.

To keep the cost of these instruments within the pocketbook of the do-it-yourselfer, it is essential that manufacturing costs be reduced to a minimum, and that machine work requiring skilled operators be eliminated where possible.

To achieve these ends, two aluminum die castings are used by the Instruments Corporation. They are used on both instruments. Made by the Mt. Vernon Die Casting Company, the castings, as received, are ready for use after only minor machining operations are done.

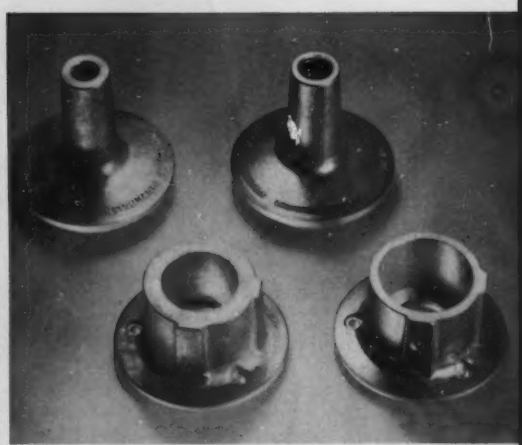
In figure 3 the two castings which act as cover member and bottom for the generator case are shown on the left. The finished castings after machining and barrel polishing are shown on the right. Since both instruments must respond instantly to very small changes in either wind speed or wind direction and must be activated by very low velocity winds, good bearings are essential, and these bearings must operate under all conditions of temperature and weather.

The head casting is made with the main bore cored with a 10° taper. This must be removed in a subsequent machining operation and a group of small holes drilled in the underside. Some of these holes are later tapped. A facing operation to insure weather tightness completes the casting, making it ready for use.



2. WIND direction indicator.

On the base casting the cored hole must be bored and a simple facing operation performed. Here again weather tightness is essential and a stepped joint is used.



3. DIE CASTINGS used as cover members and bottoms for the generator case are seen before finishing at left, afterward at right.

To secure linear response to changes in wind velocity, the anemometer employs an AC generator with the rectified output connected directly to a DC milliammeter, insuring this.

In the wind direction indicator, simple contacts are used and these, in turn, operate eight signal lights on the indicator case, so that it is possible to read wind direction to 16 compass points.

Since connection between the instruments themselves and the indicators is electrical, the distance between them may be set at any reasonable amount.

The completed instruments that mount outside have a black anodized finish to give some eye appeal and to secure a high degree of corrosion resistance.

The anemometer is calibrated for wind speeds of 100 m.p.h. and has been run at 10 percent higher speeds in a wind tunnel.

*Chief Engineer, The Instruments Corporation

A Touch here does so much

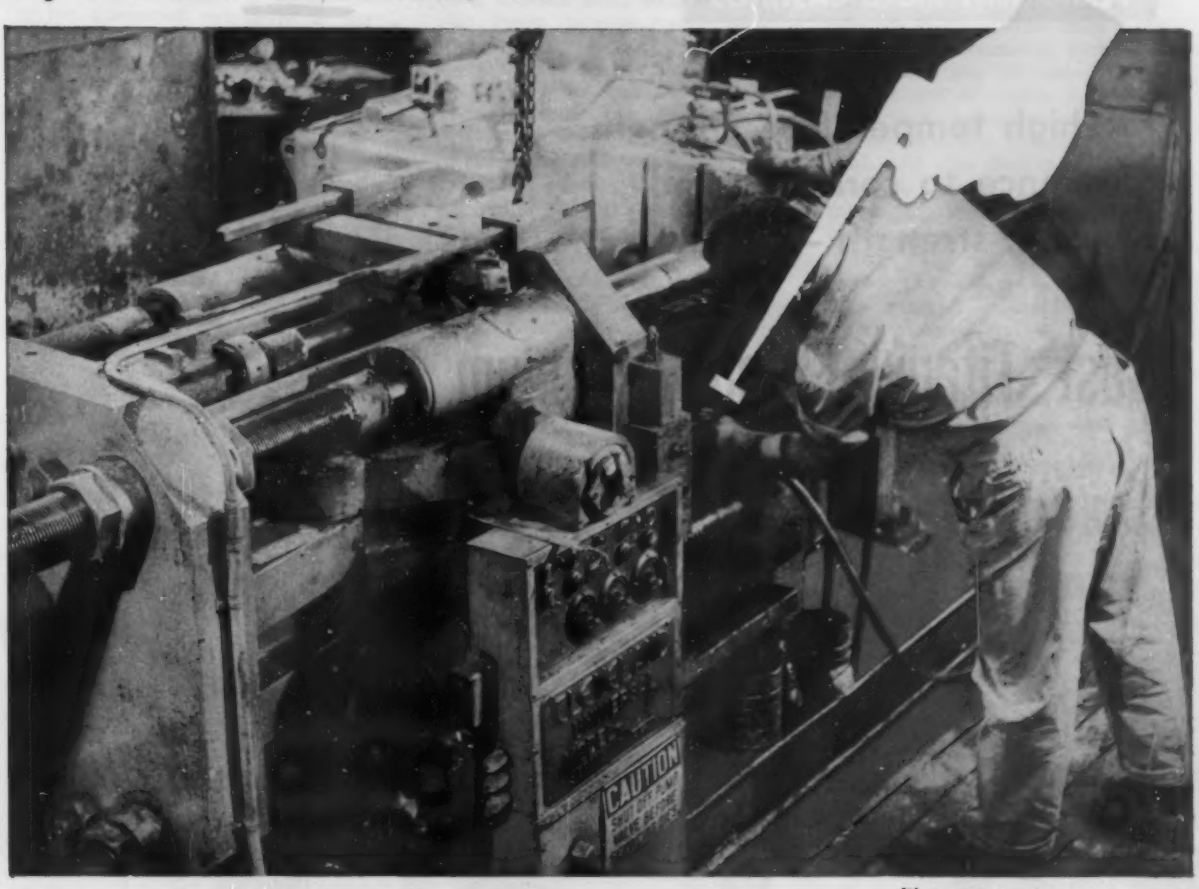


Photo courtesy Bendix Foundries

HEAT AND PRESSURE...

Conventional lubricants burn up at 400°F. So what happens when aluminum and magnesium are die cast at 1300°F.? What happens to die surfaces subjected to the scrubbing effect of 30,000 p.s.i. pressure?

The answers are unpleasant and unprofitable ... surface folds, porosity, bad parting; metal build-up on the die face, and shortened die life.

Hundreds of die casters have found a practical answer in a 'dag'® dispersion of colloidal graphite in water which lays down a thin, tough, heat-resistant film of pure colloidal graphite that penetrates everywhere and stays put. Metal flows smoothly, producing parts cast to closer tolerances with finer finish. Die life is lengthened and toxic fumes are a thing of the past.

An Acheson Service Engineer can show you the many practical benefits of 'dag' colloidal dispersions in your die casting operations. Also write for Bulletin 423 on metal casting and many other applications involving high-temperature lubrication. Address Dept. PMM-11

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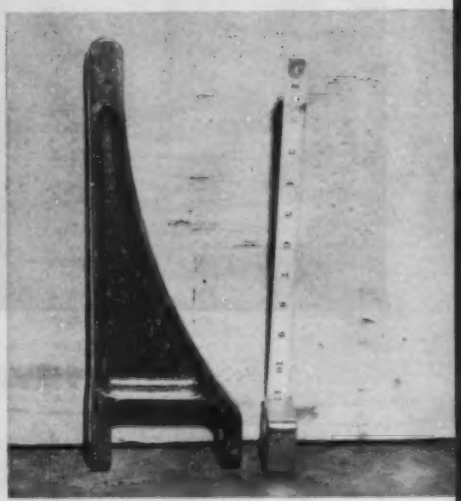
For high temperature strength, resistance to corrosion and a good strength – weight ratio use . . .

COVER STORY

Cast Titanium And Zirconium Parts

AIRCRAFT part cast in titanium and used in the aviation industry because of its toughness and resistance to the high temperatures of supersonic flight.

TITANIUM gives this item the qualities needed for efficient functioning at high temperatures.



SIZE of this part can be realized when seen with scale, above.

by **STEPHEN M. SHELTON***

THE two questions often asked first when discussing titanium and zirconium castings are "Why the interest in these two metals?" and "Why cast these metals if the process is so difficult?" The second question may be answered quite simply by pointing out that in many cases, the castings can be produced at much less cost than comparable shapes fabricated by other methods. In addition, the casting process avoids metal pick-up of atmospheric contaminants such as hydrogen, oxygen, and nitrogen encountered in fabrication techniques which require that the metal be heated in air. A third point in favor of castings, especially in the case of zirconium which is costly and which is presently in short supply, is the metal recovery factor which generally runs about 90%. while comparable shapes produced by machining from solid stock or by forging often may have a metal recovery factor of less than 40%.

The first question "Why use these metals?" will be answered differently by three different groups of potential users. Builders of atomic power reactors of the thermal neutron type use zirconium primarily because of its transparency to the slow neutrons

*General Manager
Oregon Metallurgical Corp.

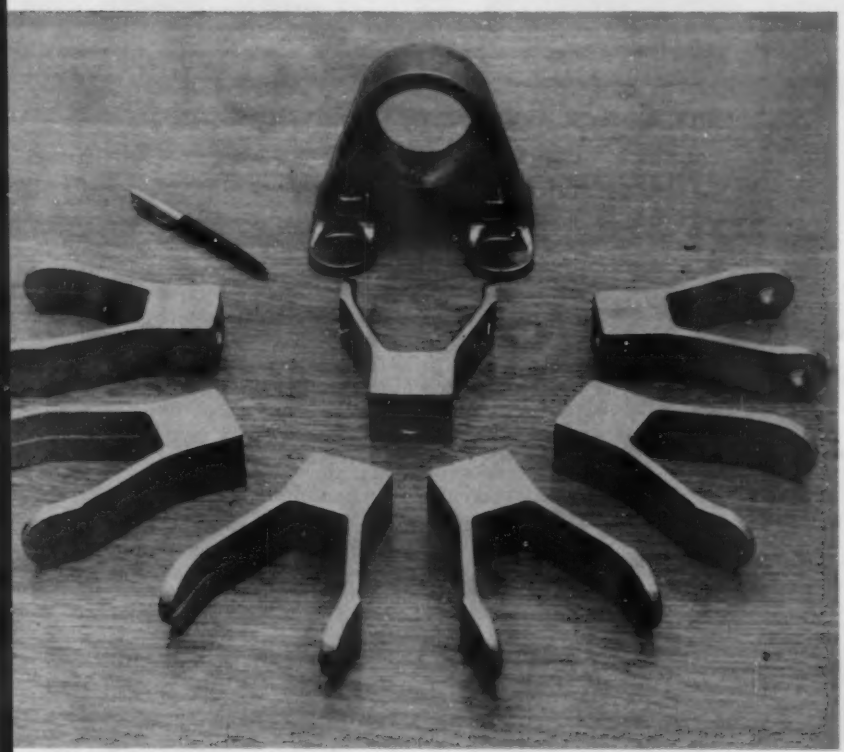
as well as its strength and resistance to corrosion when in contact with extremely hot water.

Group 2 comprises those who are interested primarily in corrosion resistance to many different media. Where strength, machinability, ductility, and weldability are also important, zirconium and titanium offer many advantages. Bulletin 561, U. S. Bureau of Mines, "Zirconium, Its Production and Properties", table 22, comparing the corrosion resistance of zirconium, titanium, tantalum, Stellite No. 6, and type 316 stainless steel shows that in such diverse applications as acetic acid, aqua regia, ammomium hydroxide, calcium chloride, wet chlorine, citric acid, cupric chloride, chromic acid, sodium chloride, ferric chloride, formic acid, hydrochloric acid, lactic acid, mercuric chloride, nitric acid, oxalic acid, and sulfuric acid below 80% concentration, titanium and/or zirconium offer a degree of resistance sufficient to indicate that they would give longer life per dollar than the other metals listed in many applications.

In cases where failure of a metallic part would mean downtime, loss of valuable chemicals, or a safety hazard, the longer life expectance of zirconium or titanium components makes them even more attractive. In addition, the cost of these components is decreasing steadily while most other metals are becoming more expensive. Units fabricated of titanium and zirconium by means other than casting have proven to be economically feasible in the past, and now that castings are available, the future of these metals in corrosive applications looks even brighter.

The third branch of industry showing an interest in these castings, primarily titanium, is the aircraft and missile manufacturers. Their interest is due almost entirely to the strength to weight ratio of titanium. With a density 60% that of steel and

Continued on page 110

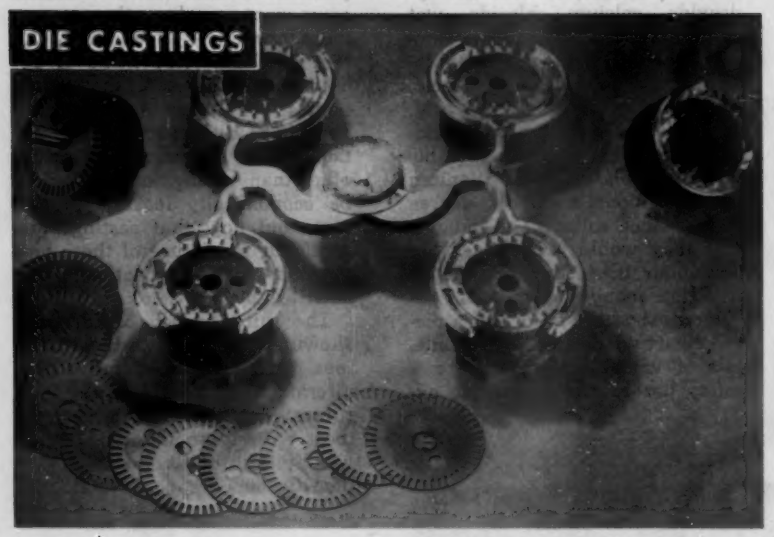


MANY PARTS cast in titanium are now a necessary part of the aircraft construction field. Fanning out in the above picture, is a selection of these items.

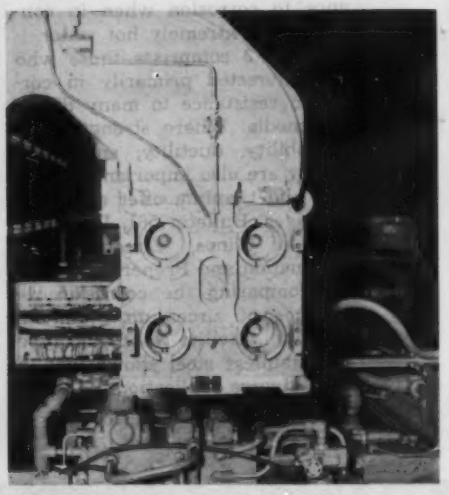
CENTRIFUGAL titanium pump. This is cast in one piece. The impeller is closed. Many of the problems typical of casting with titanium are represented here.

COMPONENTS used in the manufacture of titanium pumps.

BOOK END seen below is precision-cast in titanium, is used as cast.



DIE CAST ROTORS, the first to be produced on this new, fully automatic machine. An insert goes in, automatically, and the trimmed casting is removed.



LOADING SIDE of the automatic transfer mechanism. The only hand operation in the casting cycle is loading and pouring the shot.

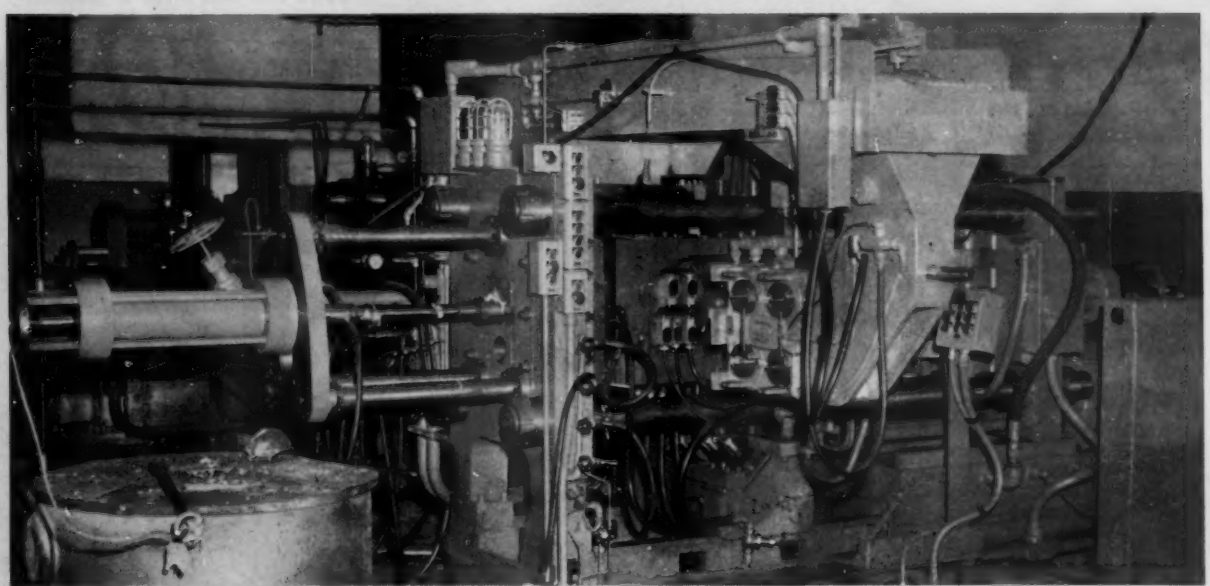
A Step Toward Automatic Die Casting

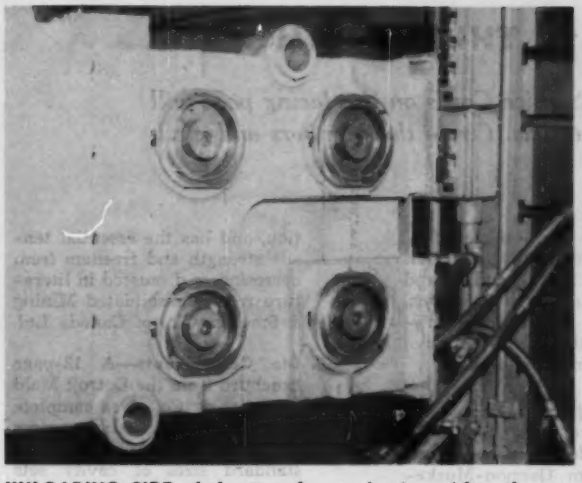
ANOTHER step toward the full mechanization of the die casting process has been made by Cast Master, Inc., with the development of a transfer mechanism for loading inserts into a die cavity and removing the finished castings from the machine.

While the present unit was developed for the specific problem of casting aluminum into motor rotors, the transfer mechanism and the associated materials handling equipment can be adapted to many other cast parts. Where inserts are not involved the mechanical removal of the casting from the die can still be employed with some economy.

In this machine, where aluminum is being cast, the speed of operations is not materially different than would be the case if manual loading and unloading were employed. When fully installed, with adequate

A die casting machine equipped with the automatic transfer mechanism. When the necessary conveyors have been added to bring up inserts, remove finished castings and carry the trimmings back to the melting pot this will be an almost fully automatic operation. Loading the inserts into the transfer device and pouring the metal are the only hand operations. The transfer mechanism can keep-up with normal cycling of the machine.





UNLOADING SIDE of the transfer mechanism. After the shot is completed the gate of castings is held by this jig. The gate trimmed off and the finished castings withdrawn and discharged onto a conveyor.

parts delivery and casting removal systems operating, the rate of finished rotor production should be materially increased over all manual operations.

In addition, there is a man-power saving and a time saving due to the elimination of trimming as a separate operation. Here's how this machine works.

Rotor stacks with a temporary center shaft in place are delivered to the machine by a conveyor. When the first shot is to be made, the operator must manually load four inserts into the cover half of the die. The shot is then made and while waiting for the metal to solidify, the operator loads four more inserts into the delivery side of the transfer mechanism. After the machine opens, with the cast rotors in the ejector half, the transfer mechanism moves between the die halves. The casting machine partially closes and in doing so places the four inserts in the cover half of the die. At the same time the cast rotors are pressed out of the ejector half of the die into the transfer mechanism. During this operation the gate, risers and flash are automatically trimmed off. Also, the temporary center shaft is pressed out and through the cover half of the die into a suitable container outside of the machine.

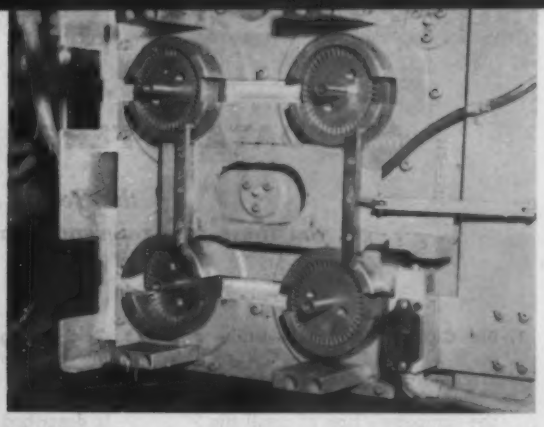
When the machine re-opens the transfer mechanism withdraws with four cast and trimmed rotors held on the discharge side. As soon as the transfer device has reached its outside limit the holding device releases and allows the finished rotors to drop onto a conveyor to be transported to finish machining.

A repeat cycle is now ready to start since four inserts are already in place. Scrap from the trimming operation falls onto a suitable conveyor and is returned to be remelted.

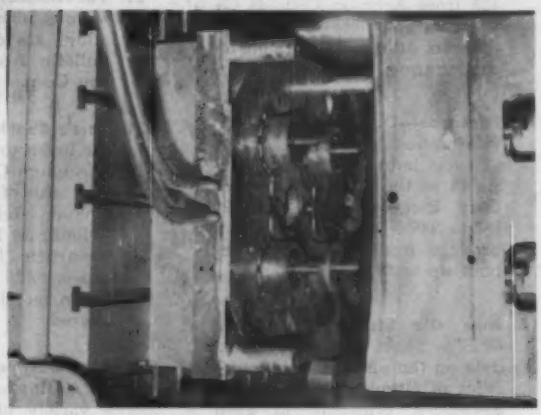
Pressure on the inserts, when the die halves close is by individual hydraulic cylinders so that the stack height may vary, within motor manufacturing limits, without affecting the casting operation.

Variation in the rotor diameter can be accommodated up to about 0.005". Beyond this limit the rotors can not be handled by the transfer mechanism.

When it is desired to use the equipment for rotors of smaller diameter they may be accommodated by installing inserts in the transfer mechanism.



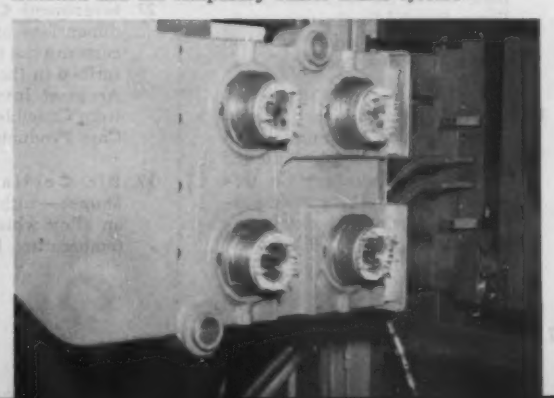
LOADED and ready to start. These inserts will be carried into the machine and placed in the cover die.



INSERTS IN PLACE in the cover die just before the machine closes and the shot made.

A GATE OF CASTINGS in the ejector half of the die ready for trimming and removal from the machine.

COMPLETED CASTINGS, the gate and all flash have been trimmed and the temporary center shafts ejected.



DATA OFFERED IN THIS MONTH'S ADS

the Reader Service Cards on the facing page will get you these free reference materials. Circle the numbers and mail.

1. **Die Casting Machines**—Bulletin P-10 from ABC Die Casting Machine Co., provides complete engineering data and prices on the company's line of small die casting machines.

4. **Colloidal Dispersions**—Bulletin 425 from Acheson Colloids Co. presents complete data on the different lubricants available for casting use.

5. **Furnaces**—Detailed technical information is available on the 60 cycle induction melting furnaces of the Ajax Engineering Corp. Ranging in size from 20 kw to 2000 kw, the furnaces will produce from 150 pounds per hour up to 40 tons per hour.

6. **New Die Steel**—The Ottawa 60 Blue Sheet contains certified data on the physical characteristics of Ottawa 60, a die steel developed primarily to deep draw and form stainless steel. Allegheny Ludlum Steel Corp.

7. **Investment Castings**—Detailed literature, "How to Design, Specify and Buy Investment Castings", from Alloy Precision Castings Co., includes descriptions of the company's modern plant and techniques.

10. **Low Cost, High Speed**—die casting machines are described and all of the specifications given in an illustrated folder from the American Die Casting Machine Co.

14. **Fluxes**—for all metal melting industries are presented in technical literature from Atlantic Chemicals & Metals Co.

16. **Dies & Related Tooling**—A complete list of the facilities at Alliance Special Products is available with other information on dies and related tooling.

17. **13 Models**—of die casting machines for zinc, aluminum and brass are described in bulletins from B & T Machinery Co. Designed and built to specification, the machines range in capacity from 100 to 750 tons.

18. **Compacting Press**—A new 50W low-cost compacting press, that is designed for versatility and has a rated pressure of 50 tons, is described in technical literature from the Hamilton Div., Baldwin-Lima-Hamilton.

20. **Vacuum-Melting**—facilities for ferrous, nickel- and cobalt-base alloys are described in a new bulletin from Cannon-Muskegon Corp.

21. **Three Booklets**—are offered by the Refractories Div. of the Carborundum Co. Besides the current issue of Refractories magazine on Refrax and a special bulletin on Refrax, a reprint of the article "Nitride-bonded silicon-carbide bridges gap between metals and ceramics", is offered.

22. **Die Casting Machines**—Eight die casting machine models with a variety of "bonus" features are described in a catalog from Cast-Master, Inc.

23. **Automatic Injector**—The first completely automatic industrial injector for wax or plastics is described in Bulletin No. 1202 from the Centrifugal Casting Supply Co.

24. **Bronze Bearing**—Booklet S-56 from Chrysler Corp., Amplex Div. contains engineering data on more than 1,000 sleeve, flange, and thrust bearings carried in stock.

25. **Die Casting Machine**—Specifications and other technical data is available on the new 800 ton hydraulic die casting machine from Cleveland Automatic Machine Co. The machine will produce castings up to 20 lbs. aluminum, 46 lbs. zinc.

27. **Investment Castings**—Accurate dimensions and lower finishing costs are the two advantages described in the booklet "Crucible Accumet Investment Castings", from Crucible Steel Co., Special Cast Products Div.

29. **Die Casting Complicated Shapes**—with Tadanac Zinc; an alloy which is ideal for low temperature high speed operation, and has the essential tensile strength and freedom from corrosion, is discussed in literature from Consolidated Mining & Smelting Co. of Canada Ltd.

30. **Die Cavity Sets**—A 12-page brochure from the Detroit Mold Engineering Co. gives complete information, including prices and specifications, on six new standard sizes of cavity sets for die casting.

31. **Precision Dynamometers**—in 13 different capacities, from 0-500 to 0-100,000 pounds, are described in a technical brochure from W. C. Dillon & Co., Inc.

34. **Cap Screws**—Special socket head cap screws are just one of the many products of the Detroit Mold Engineering Co. listed, with complete specifications, in their engineering catalog.

36. **Furnaces**—Bulletin C, from Eclipse Fuel Engineering Co., illustrates and describes 9 crucible and double chamber dry-hearth furnaces custom-designed for most metal-melting operations, in the industry.

41. **Metal Powders**—Detailed information from The Glidden Co., describes Resistox metal powders which meet all standards for purity and consistency.

42. **Small Die Cast**—parts that can be made for half of what it would cost the customer, are described in a new bulletin from Gries Reproducer Corp.

45. **Investment Casting Design**—A brochure has been published by Hitchiner Mfg. Co. to aid the engineer in designing for the best and most economical use of investment castings.

47. **Aluminum Die Casting**—A brochure, "Behind the Scenes", contains a complete digest of Hampden Brass & Aluminum Co.'s experience, equipment and facilities.

48. **Induction Melting**—Complete details on "Inducto Melters" in a capacity range from 1 to 60 pounds for investment castings are available from Inductotherm Corp.

Continued on page 70

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9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306

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5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298
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11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304
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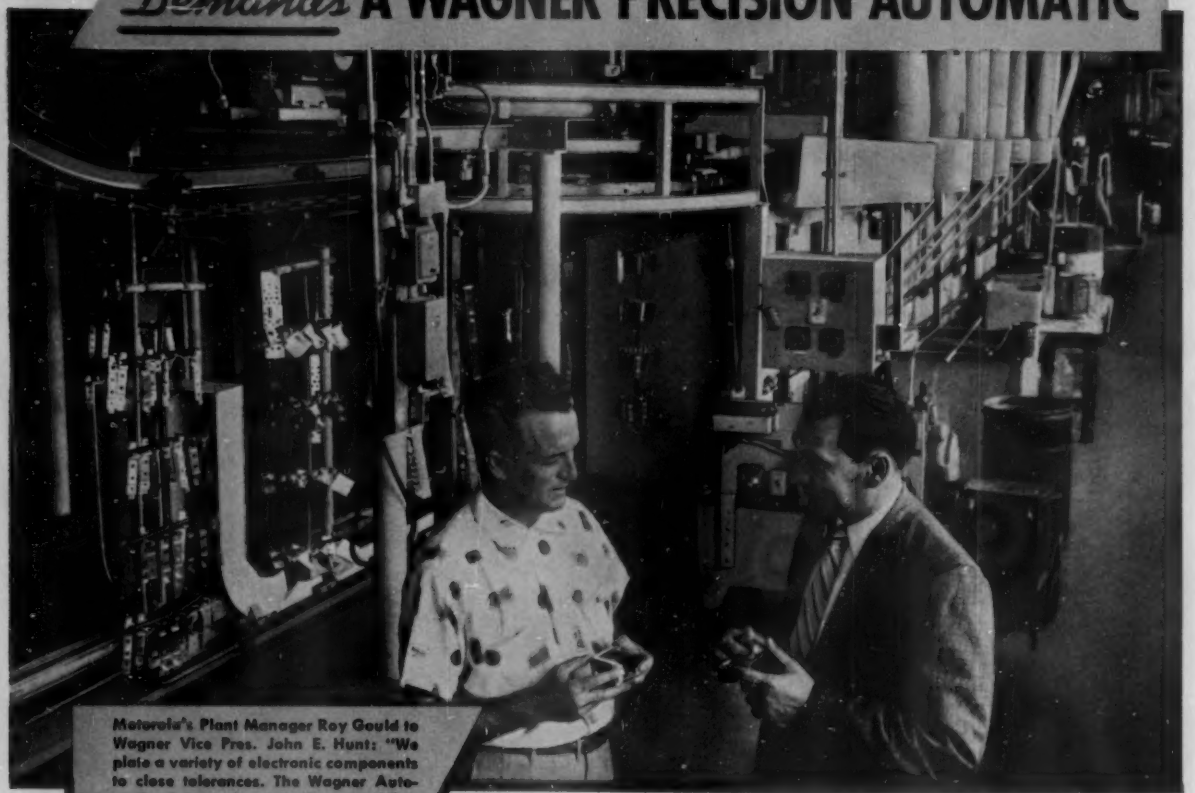
Finishing Section

The specialized finishing methods, equipment and materials used to machine, assemble, surface condition or surface coat precision metal molded parts are presented here. This includes all secondary operations which convert a raw casting to a finished product.

Die castings can be anodized to give a clear black.

MOTOROLA'S PRECISION PLATING

Demands A WAGNER PRECISION AUTOMATIC



Motorola's Plant Manager Roy Gould to Wagner Vice Pres. John E. Hunt: "We plate a variety of electronic components to close tolerances. The Wagner Automatic gives us the control we need."

Television and other electronic components are cadmium plated to specifications much more rigid than most military parts. That's why Motorola, Inc., after an intensive study of all makes of automatic plating machines in the plants of its suppliers and many other manufacturers, specified a Wagner Automatic for their critical work, a deposit of .0003″ +.000075″ —0″. This precision plating machine, designed to solve Motorola's problems but using many standard components, now produces 95% of the requirements of the Communication and Industrial Electronics Division, proof of the versatility of Wagner design and engineering.

Plant Manager Roy Gould says, "Only the Wagner Automatic offers all the features desired, in addition to the greatest output per hour of the quality plating we demand. We like the smoothness of lift and transfer, the absence of impact, the elimination of a tremendous superstructure, and the foolproof hydraulic system. The simplicity of design and the standardization of parts and assemblies enable our mechanics to handle all adjustments and maintenance. The installation was fast—and the Wagner men performed their company's contractual and unspoken obligations competently and without hesitation. Since the first week or two of running, only minor adjustments have been needed."

Remember, only Wagner manufactures the equipment and processes the chemicals required by your plant. For information on Wagner automatic plating machines and materials handling engineering services, write today or call our representative in your area.

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Extension Solves Tapping Problems

TAPPING a remote blind hole on a gear-train housing for a radar assembly is often a tedious, ticklish job.

But it is accomplished at the Curran Machine Works by means of a "tap extension", a practical device used at the Long Island City shop which specializes in unusual types of "problem" jobs.

To order special extension taps for each job would waste a lot of time and increase costs.

The extension eliminates the need for expensive pulley taps. Dull or broken taps can be changed by hand without wrenches or pliers.

Biggest inducement to use the new device is its cost-cutting possibilities. By applying the tap extension shanks to specific jobs, the finisher will be able to complete the work in a much shorter time.

In this way it will be possible for him to increase the profitable capacity of his shop.

As his time loss is reduced, so is his over-all cut in labor costs and time-wasting set-up operations which must be anticipated and included in all bidding and estimating.

Manufactured by the Ritmar Corp., 183 York Ave., Huntington, Long Island, N. Y., the extensions are available in standard lengths of nine inches.

For special applications the manufacturer will furnish them on order in extra lengths up to 36". These have special shanks.

A tap extension set containing extensions in nine diffierent sizes which will accommodate 15 various sizes of standard taps is also available on request. In summing up the new tool's applications it can be stated that to the busy job-shop owner, the tap-extension will solve most of his awkward-spot tapping problems and will cut production costs.

REMOTE BLIND-HOLE tapping with the Ritmar extension. Standard length of the part is 9" but the manufacturer furnishes them in lengths up to 36".

Tool Drills Small Holes

COST of finishing die castings have always been high when it came to drilling small, out-of-the-way holes in locations which were hard to reach with conventional equipment. These expensive operations may become much more economical in the near future, thanks to the introduction of the "Mindril", a tool designed to drill these holes easily and accurately. It has already been used with appreciable success in the manufacture of potentiometers at the Micro-Lectric Division of Micro Machine Works, Inc., Roosevelt, Long Island, N.Y.

It drills a series of tiny tap holes which are close together. Previously, this operation was costly and time consuming because each drill had to be individually soldered to an extension rod.

If a drill broke, the entire tool was discarded. The "Mindril" has eliminated these problems because the drill is inserted into a gripping mechanism. This allows quick, easy changing of dull and broken drills. No soldering or brazing is necessary and there is no need for small, special tools.

SMALL holes can be drilled accurately with the device.

PMM

SPECIAL REPORT

ROTO-BLASTING gives smooth finish.

DEGREASING removes oil, dirt.

1. A shot blasting operation removes all loose metallic particles and provides a smooth matte finish suitable for anodizing. Shot blasting is performed in a roto-blast machine. In some cases where shot blasting is not employed, the die cast parts are cleaned in an inhibited alkaline cleaner, spray rinsed, dipped in nitric acid, and finally spray-rinsed in water prior to anodizing. Caustic soda is not used in the cleaning of high silicon aluminum alloy die castings. The alkali attacks the aluminum and leaves the undissolved silicon exposed in a finely divided smutty state on the surface of the castings.

2. Die castings which have been shot-blasted are racked or placed in baskets and vapor-degreased to remove all oil, grease, and other impurities. Parts are first sprayed with cold solvent, then allowed to remain in the vapor phase until solvent vapors condense freely on the parts.

3. After de-greasing, parts are immediately transferred to the anodizing tank. Anodizing is done in a 16% H_2SO_4 solution maintained at a temperature of 70° F to 72° F for a 50-minute period. Current density is controlled by voltage. The voltage is limited to between 21 and 24 volts. Current density drops as anodizing proceeds. This step is the *key* to the entire process, since the capacity of the anodizing tank determines the number of parts that can be processed in a 50-minute cycle. The average thickness of the anodic films which are produced on high-silicon aluminum alloys is .0004".

4. After anodizing, the die cast parts are rinsed in cold water to remove excess H_2SO_4 and sulphates which if left on the die-cast parts, would

Here Are 10 Steps in Black Anodizing

THE sulphuric alumilite process, for anodizing aluminum die castings used in the fabrication of certain railway signalling devices, was installed in the General Railway Signal Company's plating department in 1948.

Anodizing was selected as the best finishing process for aluminum die castings because it provides excellent corrosion protection for aluminum surfaces exposed to a variety of corrosive conditions.

Dull-black coatings also provide an excellent non-reflecting surface and so are particularly suited for use on signal devices where non-reflectance is very important. At first, considerable difficulty was encountered in producing a consistently uniform black coating. The color of the die castings processed in the black-dye bath was more brown than black.

It was soon realized that bath-composition together with operating conditions had to be accurately controlled in order to produce a good, dense black color on high silicon aluminum die castings. Close temperature control of the anodizing solution during the anodizing cycle, length of time in the solution, and the

ANODIZING takes place here.

DYEING parts begins now.

BLACK-DYED parts hoisted out.

carry over into the dye-bath and adversely affect the pH of the dye solution, causing difficulty.

5. After rinsing, the anodized parts are immediately transferred to the black dye bath. It is maintained at a temperature of 150° F and a pH value of 5.8 to 6.2. Parts are racked on a rocker bar which provides agitation of the parts in the dye bath. It was found that agitation is essential in producing a uniformly dyed coating. Minimum time in the dye-bath is 10 minutes. It has been found necessary at times to extend the dyeing time to as much as 30 minutes in order to develop a black color that is satisfactory. A 3B aluminum black dye was found to produce the best black on high-silicon aluminum die castings. Constant checks are made to maintain proper dye contentration and pH.

6. Following the dyeing operation, parts are rinsed in hot water for 30 seconds. This removes excess dye.

7. Final sealing is done in a hot nickel-acetate solution. The die cast parts are removed from the hot water rinse and transferred to the nickel-acetate seal solution. Sealing time is 10 minutes. Temperature of the solution is he'd just below its boiling point. This prevents dye-bleeding during the final washing operations.

8. After sealing, parts are thoroughly rinsed in cold water, then rinsed again in hot water.

9. Parts are blown dry with clean, dry compressed air.

10. Loosely adherent smudge resulting from the dyeing operation is removed from the castings by buffing or tenite pellet blasting. Tenite is only used when the design of the parts makes buffing or brushing operations unsatisfactory.

CLEANED castings are air blown.

BUFFING removes loose smudge.

Aluminum Die Castings

concentration of the sulphuric acid electrolyte were found to be determining factors in the production of an anodic coating with satisfactory pore-space for dye absorption. Equally important in the production of a consistently uniform black-dye color is the control of the dye-bath.

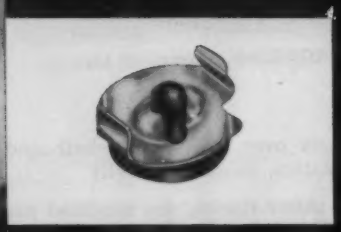
The concentration of the dye, pH, temperature of the bath, and the processing time are all important factors in producing color intensity. The most critical factor was the pH value of the dye-bath.

The aluminum alloys used principally in the fabrication of signalling devices are Al #360, ASTM-B85, SG100A, Al #13, and S12B. The aluminum parts die-cast from these alloys include bases, frames, cams, knobs, hubs, brackets, rings, and spacers. There are ten steps in the anodizing finishing system used at the General Railway Signal Co. in Rochester, New York. The finishing line, with the exception of shot blasting and vapor de-greasing, is arranged in a horse-shoe pattern to facilitate handling operations. Anodizing production rates vary considerably. They are based on the minimum figure of 100 square feet of surface per tank load.

Seven tanks per day is the usual production run. The number of die castings which are black-anodized in one day varies from 200 to several thousand, depending on the size of the castings.

DOT THREAD CUTTING FASTENER
HOLDS TIGHT TO CURVED SURFACES

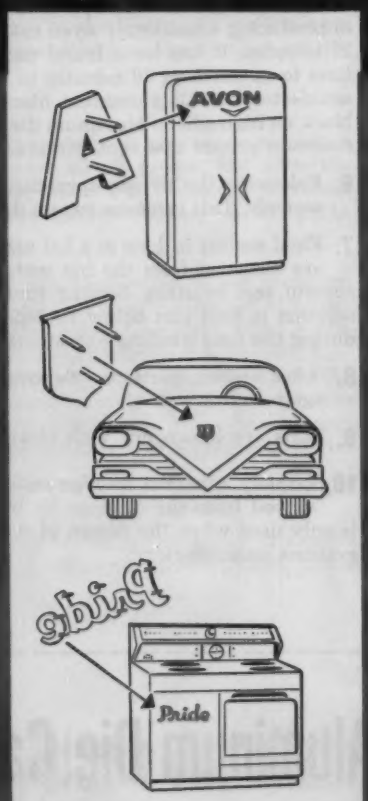
- Low Cost
- Re-Usable
- Self-Locking
- Vibration-Proof
- Spring Take-Up



Specially designed to hold die-cast or cold-forged name plates, emblems and trim against sheet metal surfaces . . . DOT'S unique T.C.F. can be used in many other applications which require a spring take-up fastener that pulls up tight without backup on flat or contoured surfaces.

It cuts clean, deep threads on unthreaded studs, even those that are chrome plated. When used with its preassembled plastic sealer, T.C.F. makes a water-tight seal. The sealer *precedes* the fastener onto the stud so that it is not damaged by the thread-cutting process.

Available *in quantity*, with or without sealer, to fit 1/8" and 3/16" studs. Drawings available on request for magnetic tool or simple hand tool.



Nominal Sizes	A	B	C	D	E	F	Driving Torque	Ultimate Strength
1/8"	.560	.170	.450	6°/4°	.095 .085	.130 .125	7-10 inch lbs.	200 lbs.
3/16"	.705	.200	.450	6°/3°	.160 .150	.192 .184	20-30 inch lbs.	400 lbs.
1/4"	.875	.260	.625	6°/4°	.190 .180	.255 .245	25-30 inch lbs.	500 lbs.

Manufactured by
ROSEBROCK MILLS SUBSIDIARY
San Leandro, Cal.

DOT T.C.F.
Patent Pending

Manufactured by
CARR FASTENER CO. DIVISION
Cambridge, Mass.

UNITED-CARR FASTENER CORPORATION

For more information circle No. 96 on the Reader Service Card

Many production problems are being solved by the . . .

Correct Uses of Self-Threading Fasteners

BY R. A. HARTMAN*

FOR many years the die casting designers have worked out well-styled heavy trim and ornamentation, then reluctantly faced the jarring problem of finding an optimum method of assembly. If the cross section, as usual, was too light to consider female threads, the most likely answer has been one of the popular washer-nut combinations and threaded studs. The majority of these have been expensive threaded steel inserts, or integrally cast studs threaded after plating. For lighter work designers have frequently relied on lighter strength sheet metal fasteners, which could be pushed on plain studs and set with a special tool.

With little deviation, greater reliance on a cast trim has been the trend in almost all consumers' goods. The price squeeze magnifies the need for better, more economical methods of assembly. There has been some relief with threaded integerally cast studs. The advantage has been limited by the need for masking studs during chromium plating, by the cost of tool maintenance, and also the spoilage rate during the threading operation.

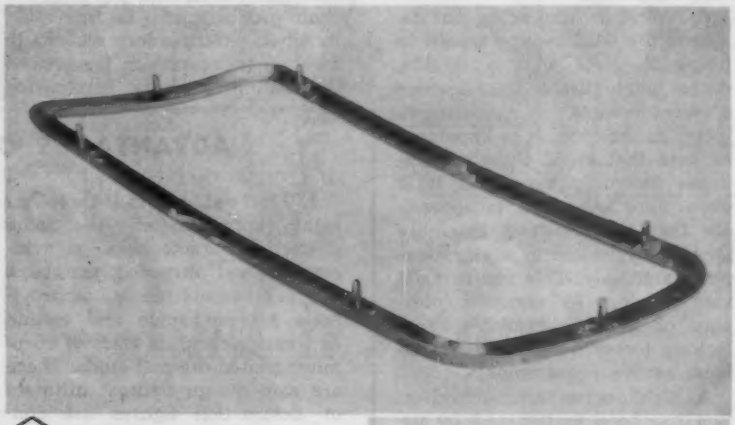
Now, however, a highly successful line of self-threading, self-locking nuts, of a sheet metal design, fill this need. They are produced in volume by the Palnut Co., in a variety of shapes and sizes, including plain hex and acorn designs. All of the designs employ a special thread form which cuts deep, clean threads in studs of any malleable material. They are particularly efficient and are widely accepted on zinc die

The Palnut Co.
*Product Development Mgr.

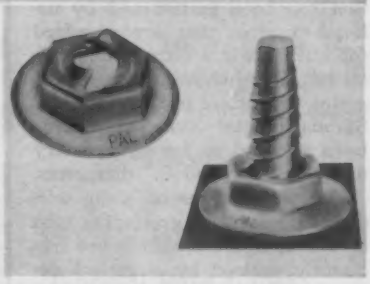
TABLE I

Stud Size	Recommended Tightening Torque	Tensile Yield Strength
⅛"	10-15 in. lbs.	100 lbs.
3/16"	30-40 in. lbs.	150 lbs.
¼"	65-75 in. lbs.	300 lbs.

APPROXIMATE tensile and torque figures for chrome-plated die-cast studs.

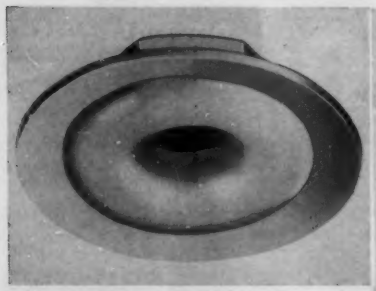


1. DIE CAST license plate frome. An example of an item which uses the self-threading nut in assembly.

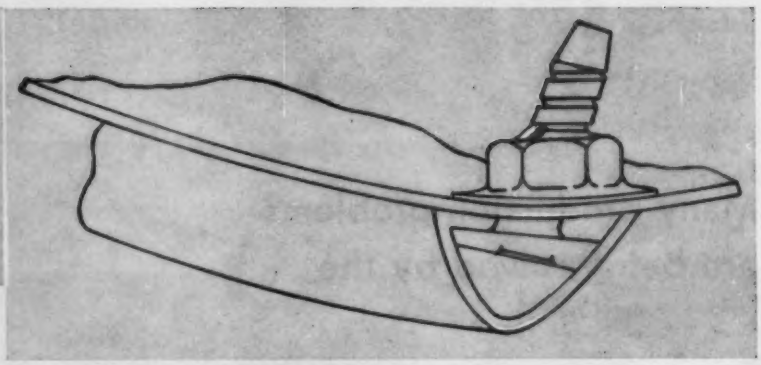


2. SELF-THREADING nut seen here is typical of those used. A safe amount of metal in the stud is dependent on the coarse-pitch thread form.

3. GROUND NIBS on this washer face are used on electrical items such as parking lights.



4. WASHER FACE allows the application of a plastic sealer. Avoiding an expensive sealing operation.



5. SIMPLIFYING DESIGNS fitting against involved, curving surfaces is possible because the studs are not required to project through the panel at a precise right angle, but can be as much as 20° off the vertical.

cast studs even though the studs are heavily chromium plated. Figure 1 shows a die cast license plate frame typical of parts currently being assembled with self-threading nuts.

A typical self-threading nut design is the washer type shown in figure 2. Note that a double, coarse pitch thread form insures a safe amount of undisturbed metal in the stud. It is important to note that rapid threading reduces assembly time, but it is even more important to appreciate that the resulting assembly is securely locked in a vibration-proof assembly. This resilient device develops an involved interplay of horizontal and vertical locking forces which exceeds the most severe requirements.

A high degree of standardization has been maintained by using hex sizes that are standard for nuts fitting a comparable size screw. The height also approximates a standard nut and washer. Standard stud sizes that have been adopted so far by industry are ⅛", 3/16" and ¼" diameters.

The washer face on some self-threaders contains grounding nibs or barbs, figure 3, which are frequently desired by electrical designers for items such as automobile parking lights. The washer face also permits the application of a highly efficient plastic sealer, figure 4, which eliminates a separate and expensive sealing operation. If it is desired, the sealer can be obtained on the grounding washer and on the plain washer.

***GAINS** to be had by using self-threaders are listed at the right. It is interesting to note them in contrast to the lighter devices that might be used in place of self-threaders. Among these advantages is the lack of need for special tools.*

Designers faced with a combination of pressures to simplify and economize, and yet improve their products, will be interested in what self-threaders will do to meet such pressure in the area of die casting assembly. In contrast to the lighter devices they might be tempted to use, self-threaders provide numerous and impressive advantages.

Chamfered or rounded ends on the studs permit an unbelievable

Continued on page 68

ADVANTAGES OF SELF-THREADERS

1. First of all, self-threaders retain approximately the same strength characteristics as with conventional threaded members. Table I summarizes an approximate set of tensile and torque figures for nominal sizes of chromium plated die cast studs. These are safe design figures; ultimate or destruction figures are considerably higher.

2. No special tools are required. Standard magnetic sockets on power or hand drivers can be used. An ordinary wrench, or in a pinch, even pliers will do.

3. The self-threader is removable with the same standard tools mentioned above.

4. The studs need not project through the panel at exactly 90° as is desirable with ordinary nuts. The studs can be as much as 20° off vertical, figure 5, and cause no difficulty. This will materially simplify many designs fitting against involved, and complicated curved surfaces.

5. Since only a slight pressure is necessary to "buck up" the assembly, a long reach in near blind locations works no hardship on the assembler. Since the device cannot cross thread, the assembler can hit the stud with his socket 10° or 15° out of line and complete a fully satisfactory assembly. A combination of these two advantages has proven that perfect assemblies can be made in some highly inaccessible locations, and gives designers some much needed freedom.

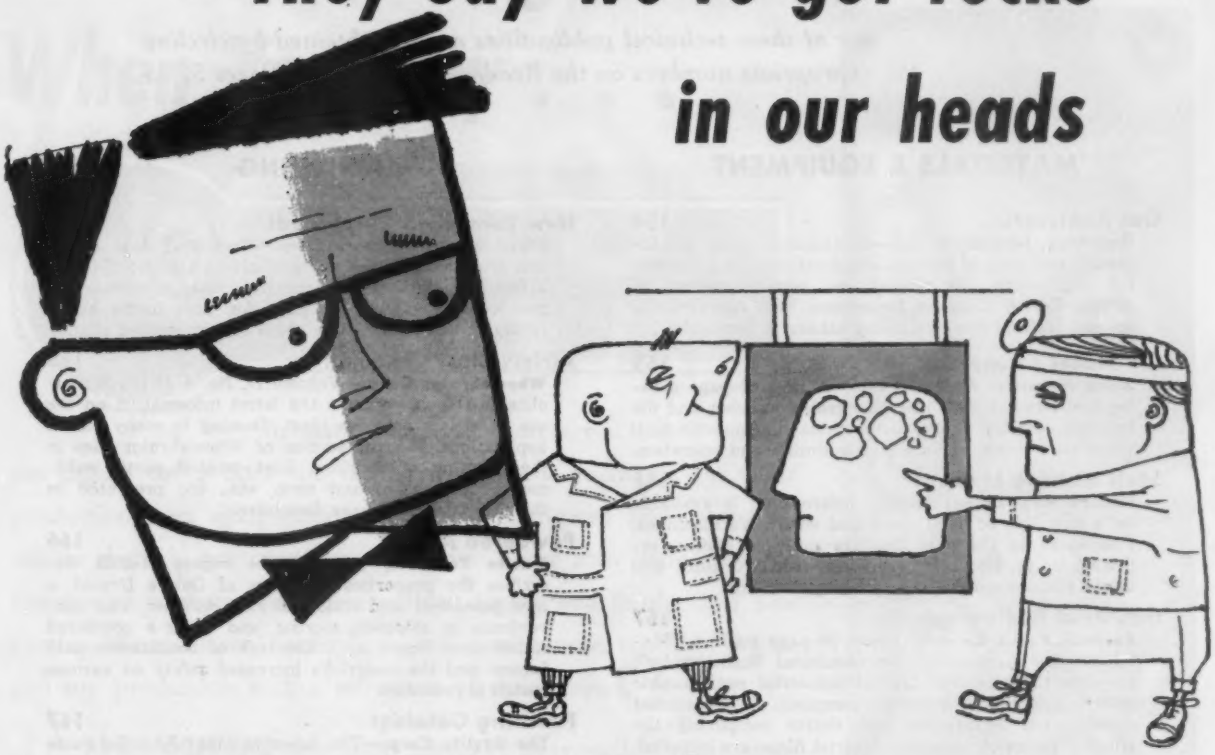
6. From the figures in Table I it is easy to appreciate that even assemblies which ordinarily would not be a good a fit can be pulled up smoothly to a tight, yet resilient, assembly that will stay tight without harm to soft or brittle finishes on the panel under the die casting operation.

7. Servicemen in the field can have no objection to the use of these parts; they can be reused and the studs will stand several removals and reapplications.

8. The self-sealing, thread cutting nut will save the handling of a separate seal member. It can not be left off because of haste or forgetfulness. With no threads on the stud, an efficient seal results.

9. A pivoted member such as a lever may be attached to a die casting with a self-threader and the prevailing torque, a characteristic of self-threaders, on the plain stud will assure permanent adjustment even though the lever is free to rotate.

They say we've got rocks in our heads



—and it's true!

We really don't mind this sort of talk. It's our business to have the types of "rocks" on our minds that are saving millions of dollars in the finishing of manufactured parts.

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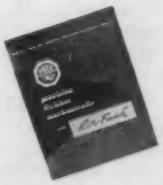

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USEFUL LITERATURE, CATALOGS, MANUALS

any of these technical publications may be obtained by circling the appropriate numbers on the Reader Service Cards, Pages 52-53

MATERIALS & EQUIPMENT

Gas Analyzers: 154
Gow-Mac Instrument Co.—Technical data on the theory and uses of thermal conductivity gas analyzers for gas purity, gas mixing and process control of Argon, Carbon Dioxide, Deuterium, high energy fuels, special atmospheres and many others, is available.

Die-Maker's Supplies: 155
Acme Industrial Products, Inc.—A new 66-page catalog features ball lock interchangeable punches and die buttons, retainer plates, die sections, die-maker's supplies, plus technical data on die design and operation.

Shell Molding Machines: 156
Osborn Mfg. Co.—Technical information is available on a new line of shell mold and shell core machines. Prominent in the new line are multiple station indexing units. They are available with two, four, five or six stations according to job requirements.

Industrial Radiography: 157
Eastman Kodak Co.— The new 16-page booklet, "Materials and Accessories for Industrial Radiography", presents the complete line of industrial radiographic materials available from the company. Recommended development techniques and charts comparing the characteristics of various industrial films, are included.

Copper Alloys: 158
The Beryllium Corp.—Nine technical bulletins and six catalogs on Beryllium copper alloys, which have resistance to wear, corrosion, magnetism, fatigue and sparking, are available from the company.

Dust Collectors: 159
Hammond Machinery Builders—Catalog No. 815 presents the complete line of dust and mist collectors manufactured by the company. This illustrated catalog furnishes detailed descriptions and specification charts on all models.

Spectrochemical Analysis: 160
Applied Research Laboratories—Volume X, No. 3 of the Spectrographer's News Letter furnishes a technical presentation on the Fuess Spectroscope for qualitative spectrochemical analysis. Illustrations and charts are included in this complete description.

Dust Collection: 161
Torit Mfg. Co.—"How much are you paying for dust?", is the theme of a new brochure explaining the economies of dust control. Photographs and application stories are used to demonstrate typical installations of both cabinet cloth filter dust collectors and cyclone separator type collectors.

Temperature Measurement: 162
Illinois Testing Laboratories, Inc.—Three bulletins, 1724, 4257 and 3197, present the company's complete line of temperature measuring instruments which include portable pyrometers and temperature controllers.

Resistance Wire & Ribbon: 163
Hoskins Mfg. Co.—A new 16-page catalog-manual covers Chromel-C, a 60-16 nickel chromium-iron resistance alloy, widely used on electrical heating applications where temperatures do not exceed 1700 F. A special 7-page section covers the do's and don'ts in heating element design.

FINISHING

New Burnishing Compound: 164
Esbec Barrel Finishing Corp.—Technical data sheets and free test samples are available on Esbec No. 203, a fine, non-dusting, non-abrasive, highly concentrated powdered compound designed for high lustre burnishing in aluminum oxide chips and in molded shapes.

Airless Blast Cleaning: 165
Wheelabrator Corp.—Volume 17, No. 4, of the Wheelabrator Digest, contains the latest information on the use of airless abrasive blast cleaning in many varied applications. A cross-section of Wheelabrator uses in the cleaning of forgings, heat treated parts, weldments, steel sheet and strip, etc., are presented in this illustrated 16-page brochure.

Powdered Acid: 166
Oakite Products, Inc.—Service report B-6564 describes the properties and uses of Oakite Drycid, a new powdered acid scale and rust remover. The convenience in shipping, storing, and using a powdered rather than liquid acid; the lack of bothersome acid fumes; and the material's increased safety on various metals is presented.

Finishing Catalog: 167
The Udylite Corp.—The latest bi-monthly price guide on the company's products is available. The item, quantity and prices (from various shipping points) are shown in easy to read chart form.

Exhaust Booths: 168
Eclipse Air Brush Co.—An illustrated brochure describes dry and waterwash exhaust booths. Fan data, diagrams and other pertinent information is included.

Blast Cleaning Hose Machines: 169
Pangborn Corp.—The new 24-page reference bulletin, for the selection and application of hand operated blast cleaning machines, includes information on methods of applying abrasives from hand operated nozzle blast cleaning units, as well as the application of both wet and soft abrasives.

57 Metal-Working Processes: 170
Turco Products, Inc.—A new 16-page manual describes in detail 57 chemical processes. Among those processes discussed are: Cleaning, phosphating, conversion coating, paint and carbon removing, electroplating, processing aluminum and maintaining of paint departments and other plant facilities. The illustrated manual also includes nine reference charts applicable to the industry.

Surface Grinders: 171
Abrasive Machine Tool Co.—Comprehensive information on the new Hydrabrasive precision surface grinder line is presented in a six-page catalog. The brochure illustrates and describes features, capacities, weights and specifications.

Solid Film Lubricant: 172
Electrofilm, Inc.—Technical bulletin #2055 describes a new one coat, corrosion resistant, solid film lubricant. Labeled 66-C, the coating is an excellent built-in dry film lubricant for operation in temperatures ranging from –65F to 600F.

Continued on page 64

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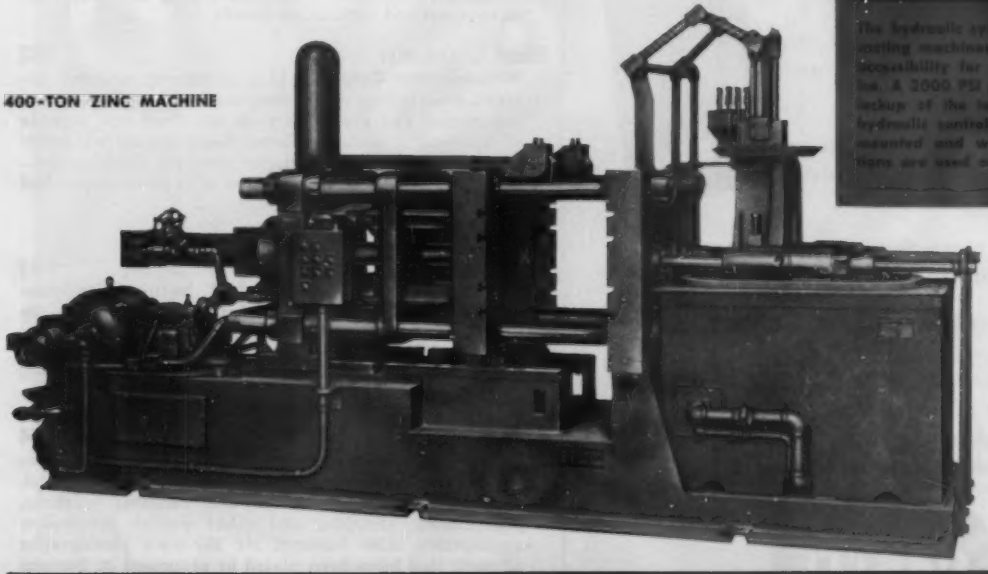

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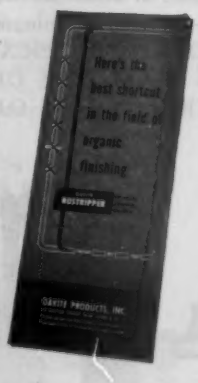

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USEFUL LITERATURE

continued from page 62

Black Finish: 173
Rollo Chemical Co.—Detailed information is available on Rollo Black Wax; a final finish for application on black oxide and phosphated pieces to impart a deeper black finish. The wax can be applied by dipping, spraying or brushing and will produce a hard durable finish in about five minutes.

Airless Blast Cleaning Machine: 177
Wheelabrator Corp.—Catalog 140-D describes the Number 2, Wheelabrator Multi-table work capacities. This versatile, high-speed, airless blast cleaning machine is equipped with either eight 24¼", seven 30¼", or five 37" diameter rubber covered worktables. It can be used for cleaning or peening operations.

Selenium, Germanium & Silicon Rectifiers: 178
F. B. Stevens, Inc.—Selenium, Germanium and Silicon rectifiers for electroplating, anodizing and all electrochemcial processing are described. The features of the company's Twin-W Rectifier line are covered as well as descriptions of the Stevens line of rheostats, line switches and a periodic-reverse plating unit.

Corrosion Preventive: 179
Parker Rust Proof Co.—Bonderite, a corrosion preventive, is featured in the latest issue of the company's external publication, "The Parkerizer." Case histories of the products many uses are given.

Buffing & Polishing Compositions: 180
F. B. Stevens, Inc.—The most recent developments in liquid and bar buffing and polishing compositions are featured in a revised 18-page data package. Sections are devoted to copper, nickel, stainless steel, plastic buffing and liquid compositions.

Phosphating Large Parts: 181
Oakite Products, Inc.—The phosphating of parts too large for tank or spray machine application is the subject of report B-6624. The bulletin explains the company's CrysCoat solutions; giving solution concentrations and application details.

Blast Cleaning: 182
Wheelabrator Corp.—A 12 page catalog contains detailed descriptions of the company's airless blast cleaning rooms. The rooms vary in size from one capable of handling a six ton railroad diesel engine weldment to one with a 100 ton capacity used for cleaning castings. Catalog 142-D is illustrated with photographs and phantom drawings.

Automatic Rack Processing & Plating Machines: 183
F. B. Stevens, Inc.—Bulletin 261 features the company's automatic rack processing and plating machines for electroplating — anodizing and other treatments of aluminum — dichromate, stripping, cleaning, pickling, bright dipping, phosphating and similar immersion processes.

Automatic Barrel Plating & Processing: 184
Stevens, Inc.—This 14-page comprehensive bulletin features automatic barrel processing for zinc, nickel, copper, tin and cadmium plating, cleaning, washing, phosphating, stripping and other similar immersion applications. Also featured are 189 scale photographs of parts that have been plated or processed in Stevens Automatic Barrel Machines.

Low Temperature Brazing: 185
Handy & Harmon—The latest issue of the company's "Low Temperature Brazing News" contains three case histories on the application and development of Easy-Flo and Sil-Fos.

Abrasive Blast Cleaning: 174

Pangborn Corp., 20-page reference bulletin. Bulletin 703 presents automated techniques for high speed blast cleaning, construction features of the company's "Rotoblast" units, layout aids, and a special section on abrasive coverage. Included is a chart showing how units can be adapted to automation.

Pan Cleaning Machine: 175

Ransohoff, Inc. Complete information is available on a new automatic work and tote pan cleaning machine. Designed to do the work of two machines, it is widely adaptable for any parts handled in tote pans, boxes, or similar containers.

Blast Cleaning Equipment: 176

Wheelabrator Corp. Descriptive bulletins on four new Wheelabrator Continuous Tumblasts, airless abrasive blast cleaning machines, with the new end-discharge construction, contain diagrams, line drawings, and cutaway illustrations on each model. A distinctive feature is that no operating labor is required.

Grinders: 186

Martin Grinding & Machine Works Inc., 4-page illustrated folder. A description of the company's line of grinders is given with complete information as to tolerances attainable and other data.

Wash Concentrate: 187

Merix Chemical Co., single-page bulletin. A superconcentrated neutral wetting agent for quick cleaning of plastic, metal, glass, china, and rubber articles is described. Instructions for use and prices are included.

Metal Stripping: 188

MacDermid, Inc. Information is given on a fast and trouble-free metal stripper for plating-room use. It is said to eliminate costly rack maintenance and repair, cut maintenance and handling costs.

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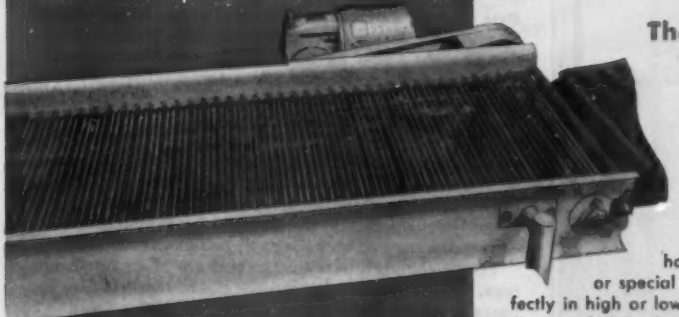

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Why not send for a FREE SAMPLE SECTION of DUR-A-GRID METAL BELTING, catalogue, prices and complete specifications today or better yet consult with one of our Conveyor engineers stationed throughout the nation and let him show you how this new low cost conveying system can pay dividends to you.

STROMAN FURNACE & ENGINEERING CO.
Franklin Park, Illinois

For more information circle No. 81 on the Reader Service Card

Machine Tools: 189

Walker-Turner Div., Rockwell Mfg. Co.—Detailed descriptions are provided, in a new 48 page catalog, on the complete line of light-heavyweight machine tools — including new tools recently introduced — and accessories made by the company. A separate listing gives the capacities, speeds and dimensions.

Socket Head Cap Screws: 190

Detroit Mold Engineering Co.—Literature is available on socket head cap screws, which range in sizes up to 12" long, and socket head stripper bolts which have shoulder diameters from ¼" to ¾" and shoulder lengths from 1" to 6".

Gas Generators: 191

A. A. Straub Co.—Three basic types of gas generators — Endothermic, Exothermic and Nitrogen, are discussed in a new, two color, brochure. A table is included on the application of gas generators in eight major processing industries.

Signalling Controller: 192

Leeds & Northrup Co.—Data Sheet ND47-33(1), gives detailed information on the company's new Thermocouple Electrimax Signaling Controller for Two-Position Control. The unit is designed to provide low-cost electronic control for many processes where a record or continuous indication is not required. Drawings and specifications are included.

Metal Cutting Coolant: 193

Folden Chemical Ltd. Complete information is available on a new type of coolant formulated to step up tool life in cutting all metals, especially the newer and harder stainless alloys. The coolant, said to increase tool life up to 2,000 percent, is said to leave no film on parts and will not form rust on tools, parts, or machines.

Spectrographic Equipment: 194

Bausch & Lomb Optical Co., 32-page manual. A new program to aid industrial firms in selecting the correct spectrographic equipment to suit their needs is explained in booklet D-277. Included is a description of the company's complete line of spectrographic equipment, from basic educational units to complex instruments for industrial and scientific laboratories.

Hydraulic Systems: 195

Kobe, Inc. 4-page technical bulletin. Bulletin No. 56TS2 gives technical information and service data on two sizes of the company's high pressure pumps and power units; designed to serve as heavy-duty sources of hydraulic power for hydraulic systems. Cutaway photos illustrate both units.

Micrometer Adjusted Drill Stop: 196

Scully-Jones & Co., 4-page bulletin with price list. An improved drill stop with a micrometer depth adjustment for drilling and reaming applications is described in Bulletin 18-50. Construction and use of the tool are described with photographs and two-color diagrams.

High-Power Ultrasonic Generators: 197

Acoustica Associates, Inc. Bulletin DR-2000 provides details on two models of the company's high power ultrasonic generators in use for powering large-scale, high-volume batch or automated ultrasonic cleaning, machining and liquid processing systems. Several typical tank arrays are illustrated, and possible cost savings are described.

Cyclone-Type Dust Collector: 198

Torit Mfg. Co. Full information is available on the model 219-FB-55 dust collector, the largest cyclone separator unit in the company's line to be fitted with connections to standard 55-gallon drums.

Bata cuts mold cleaning time in half with Pangborn Hydro-Finish

Bata Shoe Co., Belcamp, Md., used to clean shoe molds by pickling. For a better cleaning job, Bata replaced this process a year ago with Pangborn Hydro-Finish. Today this machine gives Bata top quality cleaning, does the job *in half the time* required by pickling and has required "no maintenance whatsoever." Also, acid disposal problems have been eliminated.

Says Mr. Albert Kotras, Research, "We thought it was sales talk but the Hydro-Finish has lived up to every claim the Pangborn representative made." Convinced by the performance of its Hydro-Finish machine, Bata management now plans to order a second one.

Today, through new design and use of air jet sluriators, Pangborn Hydro-Finish costs less originally, costs less to maintain and gives you easier handling and added efficiency. Write for Bulletin 1403 to PANGBORN CORP., 3500 Pangborn Blvd., Hagerstown, Md. *Mfrs. of Blast Cleaning and Dust Control Equipment.*

USE PANGBORN HYDRO-FINISH FOR:

Deburring • Surface finishing • Finishing threaded sections • Improving cutting tool life • Maintaining dies and molds • Removing grinding lines • Removing heat treat scale • Preparing surfaces for coatings, platings, etc.

Pangborn

BLAST CLEANS CHEAPER

For more information circle No. 93 on the Reader Service Card

Hose, Hose Ends: 199

The Weatherhead Co., Ft. Wayne Div., 40-page catalog. Complete and detailed information on bulk industrial hose, permanently attached hose assemblies, swaged hose assemblies and ends, hose and swivel adapters, assembly instructions and installation data are given. The company's complete line is shown in concise style for quick reference and easy ordering.

Diamond Compounds: 200

The Amplex Corp., 4-page bulletin and price list. The company's line of pure diamond compounds are described and priced. Listed are grades from ½ to 170 micron range in a variety of concentrations, plus "WC" diamond compound for finishing tungsten carbide, heavy concentration only.

Industrial Gas Equipment: 201

Linde Co., div. of Union Carbide & Carbon Corp., 24-page catalog. Form 4486, Oxweld Catalog Section 4, describes industrial gas manifolds with automatic controls available from the company. Acetyline generators capable of delivering from 100 to 9,000 cu. ft. of acetylene per hour are also included.

Pallet-Transfer Assembly Machine: 202

Syracuse Special Machine Co., Inc., 4-page bulletin. Bulletin No. PT-10 describes a new pallet-transfer assembly machine featuring standard-section construction, wide flexibility, and permitting quick re-tooling. Diagrams illustrate the different assembly layouts possible with the units.

Industrial Hose, Fittings: 203

Aeroquip Corp., 12-page catalog. Catalog Bulletin 182 contains information on the company's standard industrial hose, fittings, socketless kits, and self-sealing couplings. Designed primarily for use in the replacement field, the catalog includes instructions for ordering, installation, planning, and assembly of hose and fittings.

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ALUMINUM & ZINC DIE CASTING

For more information circle No. 101 on the Reader Service Card

JELRUS
Investment Castings

HELP PUT THESE JETS IN THE AIR . . .

Investment Castings by JELRUS provide the design flexibility and close tolerances demanded by advanced engineering techniques in the jet age.

Other important advantages to you—whether you make flying machines or sewing machines—are inherent in JELRUS-produced Castings:

- **Time and labor savings in machining**
- **Low tooling costs permitting economies in long or short run production**
- **Casting an assembly of several parts as one piece**
- **Wide choice of ferrous and non-ferrous alloys, offering required engineering properties**
- **Rigid inspection techniques (Castings produced under X-ray, zyglo and magnaflux control)**

We'll be glad to quote promptly, from your parts or blueprints; or request a visit from our local representative.

Write for Free Manual on JELRUS Investment Castings

JELRUS PRECISION CASTING CORP. 615 WEST 131st STREET NEW YORK 27, N. Y.

For more information circle No. 52 on the Reader Service Card

FASTENERS

continued from page 60

degree of freedom to the workman, but even with practically flat ends on the studs, starting is easier than with threaded studs and conventional nuts. Normal commercial tolerances on the stud diameters are adequate. The diameter at the point where the self-threader "tightens home" on the stud is satisfactory if it is within plus or minus five thousandths of nominal.

Of all the devices commercially available to date for this type of assembly, none appears to be more adaptable to automation. Although no automated drivers are now available, it is conceivable that the shape of the self-threader and its ease of assembly may lead more quickly to such development. The impact of self-threading nuts on the die casting industry already appears to be approaching that of the familiar self-threading screw.

LETTERS

continued from page 20

sary was compiled by the Norton Company in cooperation with the Esbec Barrel Finishing Corporation and GRINDING and FINISHING magazine. It has been called to our attention that the original Glossary of Barrel Finishing Terms was originated by Morris S. Shipley and William A. Biebel of Esbec Barrel Finishing Corporation and published in the September 1955 issue of GRINDING and FINISHING magazine, and was copy-righted in 1955. This original glossary was subsequently revised and published by the Norton Company with permission from Morris Shipley and William Biebel, and the GRINDING and FINISHING magazine." — O.S.T.

H. A. EY, JR. APPOINTED MGR. H-VW-M CLEANER SALES

H. A. Ey, Jr.

Hanson-Van Winkle-Munning Co., manufacturers of electroplating and anodizing processes, equipment and supplies, announced the appointment of Herman A. Ey, Jr., as manager of cleaner sales. His headquarters will be in Grand Rapids, Mich., at the company's midwest cleaner plant.

Mr. Ey's sales background includes electroplating supplies and equipment, as well as specialized cleaning products and equipment for barrel finishing.

PENNSALT CHEMICALS CORPORATION FORMS CANADIAN SUBSIDIARY

Pennsalt Chemicals Corporation has announced the formation of a wholly-owned subsidiary in Canada. The new division will be known as Pennsalt Chemicals of Canada, Ltd. "Through this new subsidiary," President William P. Drake stated, "Pennsalt will be able to provide improved customer service for its expanding chemical specialties markets in Canada."

William B. Billingsley, who has directed Pennsalt specialty sales in Canada since 1954, has been named vice-president of the new subsidiary and resident manager of its operations. Before joining Pennsalt, Mr. Billings was with Canadian Industries, Ltd.

Air powered—100,000 RPM. No shop can afford to be without this fast, flexible, low cost tool.
It grinds, deburrs, cuts, polishes, engraves. Ideal for precision finishing. Fits your hand like a pencil—responds as easily.
Weighs only 5¾ ounces. Has only one moving part—the lightweight aluminum rotor. Operates on 80 to 100 pounds of air line pressure. Takes cutting tools of any diameter up to ¼" (⅛" shank).
Comes complete with Bellows Lubri-Air Filter and Lubricator, 6' of flexible nylon reinforced air hose.

617-B *Patent Pending

Write for free bulletin today!
Address Dept. PMM 1157, The Bellows Co., Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ont.

The Bellows Co.
AKRON 9, OHIO

For more information circle No. 86 on the Reader Service Card

(Advertisement)

SPECIAL REPORTS ON FINISHING NON-FERROUS METALS

NUMBER III—Lustrous, Corrosion-Resistant Finishing with Chemical Polishing Iridite

WHAT IS IRIDITE®?

Briefly, Iridite is the tradename for a specialized line of chromate conversion finishes. They are generally applied by dip, some by brush or spray, at or near room temperature, with automatic equipment or manual finishing facilities. During application, a chemical reaction occurs that produces a thin (.00002" max.) gel-like, complex chromate film of a non-porous nature on the surface of the metal. This film is an integral part of the metal itself, thus cannot flake, chip or peel. No special equipment, exhaust systems or specially trained personnel are required.

Chromate conversion coatings are widely accepted throughout industry as an economical means of providing corrosion protection, a good base for paint and decorative finishes for non-ferrous metals. Certain of these coatings also possess chemical polishing abilities that have luster-producing, as well as corrosion-inhibiting, effects on zinc and cadmium plate, zinc die castings and copper alloys. However, continued developments in this field have been so rapid that many manufacturers may not be completely aware of the breadth of application of this type of finish. Hence, this discussion of the many ways in which this chemical polishing characteristic can be used in final finishing or pre-plating treatments to produce a lustrous appearance with distinct display and sales appeal and appreciable savings in cost. Report I on decorative, corrosion-resistant finishes and Report II on paint base corrosion-resistant finishes are available on request.

The degree of luster possible on a surface is a function of the degree to which the surface can be smoothed. Leveling to provide a smooth surface can be achieved by mechanical or chemical means, or a combination of these, depending upon the luster desired and the original condition of the metal. Chemical polishing effectively imparts luster otherwise difficult and costly to obtain. For this reason, it is often used to supplement or entirely replace mechanical polishing, depending upon the application and the original condition of the metal. Chemical polishing has the additional advantage of providing overall treatment of the submerged part. It reaches into even the deepest corners and recesses that are otherwise inaccessible. Certain of the Iridites are specifically designed to perform this chemical polishing operation. Also, they provide corrosion protection as do all Iridites, thus may be used as a final finish or a pre-plating polish.

If Iridite is to be used as a final finish, in contrast to pre-plating treatment, the chromate conversion coating generated is allowed to remain, providing good corrosion resistance. Color inherent in these Iridite films ranges from a yellow cast to yellow iridescent. These coatings may be used without further treatment where this color is acceptable and good corrosion resistance is desired. Further, these basic coatings can be tinted by dyeing. Among the dye tints available are shades of red, yellow, blue and green. If desirable, the basic coatings can also be modified by a bleach dip leaving a clear bright or blue iridescent finish. In all cases bleaching reduces corrosion resistance.

As examples of this type of final finishing, Iridites #4-73 and #4-75 (Cast-Zinc-Brite) make possible for the first time, lustrous chemical polishing of the as-cast surface of zinc die castings. Thus, in many cases, sizeable savings in finishing cost are realized by elimination of plating costs. This economical method can be used on tools, appliance parts, toy pistols, locks and many other small castings. Another example is the treatment of copper and brass parts, such as welding tips, to eliminate buffing and provide additional corrosion resistance. In many cases, handling costs are reduced appreciably by replacing piece-part handling with bulk processing. Still another example of the use of this chemical polishing and protective quality of Iridite is a simple system of zinc plate, Iridite and clear lacquer instead of more costly electroplated finishes. Typical of this type of lustrous finish are builders hardware and wire goods.

As a pre-plating treatment, in contrast to final finishes, Iridite can be used to chemically polish zinc die castings or copper prior to plating. In such cases, Iridite should be applied as an in-process step, so that the protective film is removed before the plating cycle. The savings in handling, material and labor costs are obvious. This process has made it practical to plate chrome directly over copper on steel, conserving nickel, yet producing a lustrous chrome finish. Used after stripping faulty plate in reprocessing zinc die castings, Iridite restores luster to the casting, thus making possible replating without blistering.

Other Iridite finishes are available to produce maximum corrosion resistance, a wide variety of decorative finishes and excellent bases for paint on all commercial forms of the more commonly used non-ferrous metals. As a final finish, appearance ranges from clear bright to olive drab and brown and many films can be bleached or dyed. As a paint base Iridite provides excellent initial and retentive paint adhesion and a self-healing property which protects bare metal if exposed by scratching. Iridites have low electrical resistance. Some can be soldered and welded. The Iridite film itself does not affect the dimensional stability of close tolerance parts.

Iridites are widely approved under both Armed Services and industrial specifications because of their top performance, low cost and savings of materials and equipment.

You can see then, that with the many factors to be considered, selection of the Iridite best suited to your product demands the services of a specialist. That's why Allied maintains a staff of competent Field Engineers—to help you select the Iridite to make your installation most efficient in improving the quality of your product. You'll find your Allied Field Engineer listed under "Plating Supplies" in your classified telephone book. Or, write direct and tell us your problem. Complete literature and data, as well as sample part processing, is available. Allied Research Products, Inc., 4004-06 East Monument Street, Baltimore 5, Maryland.

For more information circle No. 85 on the Reader Service Card

"Tough" Investment Casting jobs are the rule at ARWOOD, not the exception.

Intricate shapes, unusual contours, fine detail, metals and alloys difficult or impossible to machine, rigid quality control specifications, unyielding performance requirements . . . Add them all together and they total a "tough" job.

Expert research, design and development staffs, multi-plant tooling, casting and finish-machining facilities, Government-approved heat treating and inspection equipment, 54 field engineers in 20 major industrial centers . . . Add *them* all together and *they* total ARWOOD quality, reliability and know-how. More than a match for any "tough" job. Do YOU have one to try us out on?

ARWOOD PRECISION CASTING CORP.
323 W. 44th St., New York 36, N. Y.
"Pioneers in Investment Casting"
For more information circle No. 13 on the Reader Service Card

DATA IN ADS—continued

49. **Furnaces**—"Efficiency In Melting" is the title of a new booklet from International Foundry Supply Co. Doubled lining life, increased operator output, and lower fuel costs are among the features discussed about these furnaces without crucibles.

51. **Investment Casting**—"Cast to Outlast", is the title of a 16-page booklet of illustrated case histories that may suggest practical answers to your small parts problems. The International Nickel Co., Inc.

52. **Investment Castings**—The advantages of design flexibility and close tolerances found in investment castings by Jelrus Precision Casting Corp. are presented in a new manual.

53. **Aluminum Alloys**—Information is available on a new series of high purity alloys with superior properties in tensile strength, shock resistance, dimensional stability, ductility and corrosion resistance, from William F. Jobbins, Inc.

54. **Investment Casting Furnaces**—Detailed information is available from Detroit Electric Furnace Div., Kuhlman Electric Co., on two direct-casting furnaces for investment casting.

56. **Die Casting Machines**—Bulletin 101 from Lester-Phoenix, Inc. gives specifications and complete descriptions of their line of die casting machines.

58. **Die Casting**—Informative literature is available on specialized designing for magnesium and aluminum die castings from Litemetal Dicast, Inc.

65. **Vacuum Furnaces**—The latest copy of the progress report to the metals industry describing Kinney Vacuum Furnaces is available from Kinney Mfg. Div., The New York Air Brake Co.

66. **Zinc Die Castings**—is the title of an informative folder from The New Jersey Zinc Co., describing the complex shapes that can be achieved by this process.

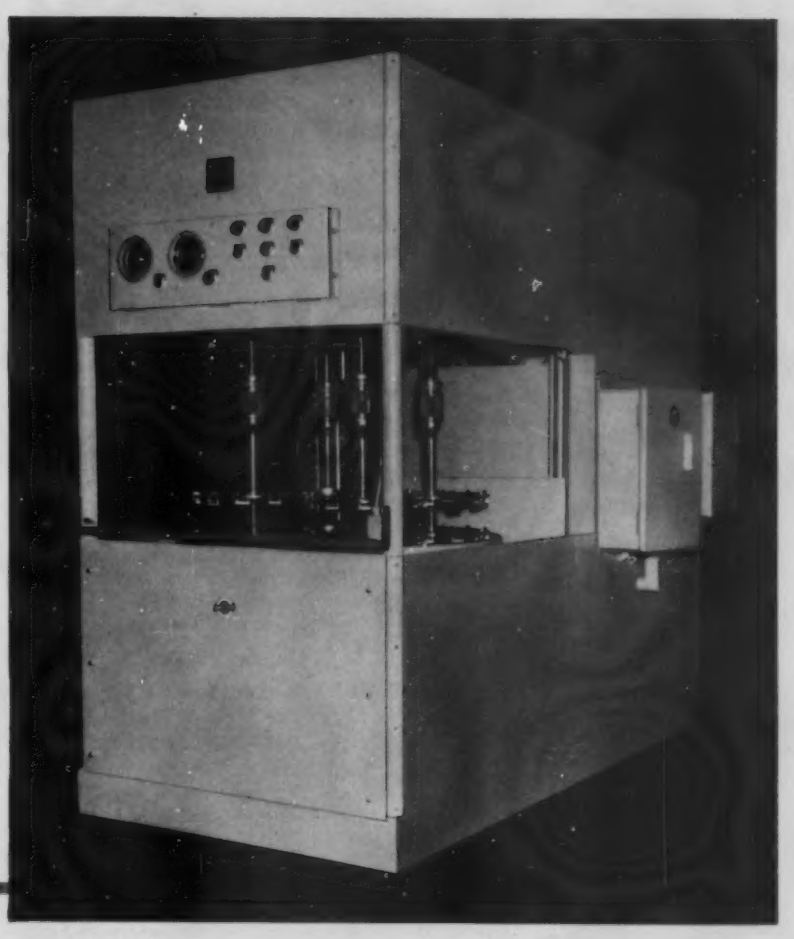
67. **Brass Powder Parts**—Detailed information on the design properties, production, and application of brass and other non-ferrous powder parts is available from The New Jersey Zinc Co. Included are 20 case histories.

Continued on page 88

TUMBLE
GRAV-I-FLO
FINISH

OFFERS

Spin-Finish



AN ENTIRELY NEW PARTS-FINISHING PROCESS

Replaces hand and automatic buffing!

- ☑ One-operation finishing, even of the most complex parts
- ☑ Completely dry process . . . no lubricants needed
- ☑ Dust and fume free . . . no need for exhaust or ventilating systems
- ☑ No set-up time required for changing jobs

Sets New Standards In Pre-Plating Finishing Costs

Wipe the slate clean of all present concepts of speed, efficiency and costs in pre-plating finishing of brass, zinc-base and aluminum die-cast parts! In one short, automatically-timed operation—and on a *multiple mounting* of parts—new SPIN-FINISH produces surfaces and lustre equal to or surpassing that of buffing.

Savings on time, labor and plant space are tremendous! Eliminated are vast exhaust and ventilating systems! You'll want to learn all about this startling revolutionary method of finishing. Write for complete information now.

GRAV-I-FLO CORPORATION

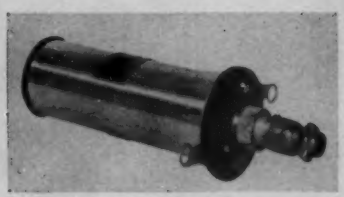
Dept. PMM 11, 400 Norwood Avenue, Sturgis, Michigan

For more information circle No. 88 on the Reader Service Card

NEW PRODUCTS AND DEVELOPMENTS

Want complete details on these announcements? Use the Reader Service Cards. You'll find them facing page 52 of this issue

HIGH TEMPERATURE PYROMETER MEASURES RADIANT ENERGY



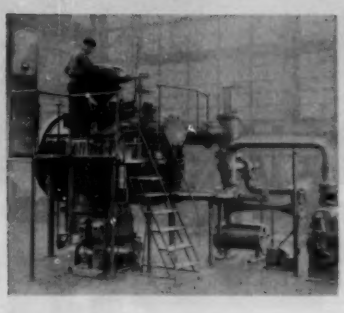
A new high temperature measuring instrument accurately measures the temperature of hot objects without touching them. The Land Radiation Pyrometer, manufactured by the Instrument Div. of Robertshaw-Fulton Controls Co., measures the radiant energy given off by hot objects.

The instrument is useful in measuring the temperature of objects beyond the normal range of thermocouples, moving objects, and where corrosion or other conditions eliminate the use of conventional resistance temperature detectors.

Radiation from the hot object is focused on a small aperture in front of a thermopile, consisting of a bank of ten thermocouples connected in series. Only 2 seconds are required for 98% of full reading. Several models are available for ranges between 1000 and 3000 F.

Circle No. 205 on Reader Service Card

VACUUM INDUCTION MELTING FURNACE HAS 50- TO 300 lb. CAPACITY



Flexibility in a wide variety of applications, is the design concept of a new 50- to 300-lb. vacuum induction melting furnace.

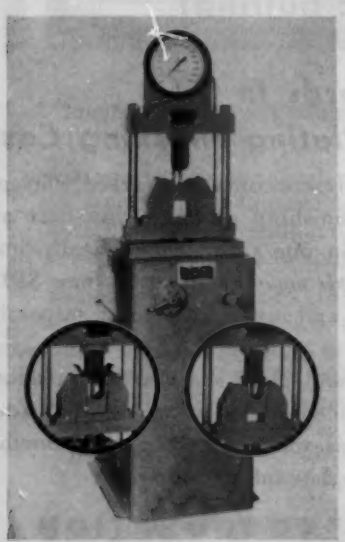
The FIM-300, developed by the Rochester Div. of Consolidated Electrodynamics, has an 8' long, 5' diameter chamber, a 2900-liter-per-second diffusion-ejector pump, and a 310-cfm mechanical pump.

Standard equipment includes two observation windows, a bridge breaker, and a sight tube. Two spare ball-and-socket joints are provided for use with such standard accessories as a thermocouple assembly, a sampling device, or an optical sight tube. A 12" blanked-off flange over the crucible allows for easy and inexpensive addition of a bulk-charging chamber.

The standard well accommodates molds 48" in height and the mold table permits 42" molds.

Circle No. 206 on Reader Service Card

GUIDED BEND TESTER DESIGNED FOR TESTING BUTT-WELDED SAMPLES



Model GB-124 Guided Bend Testing Machine was developed to test butt-welded samples in accordance with the qualification procedure of the American Welding Society, and The American Society of Mechanical Engineers. This completely self-contained unit was designed for guided bend testing with improved accuracy, faster testing and greater convenience in operation.

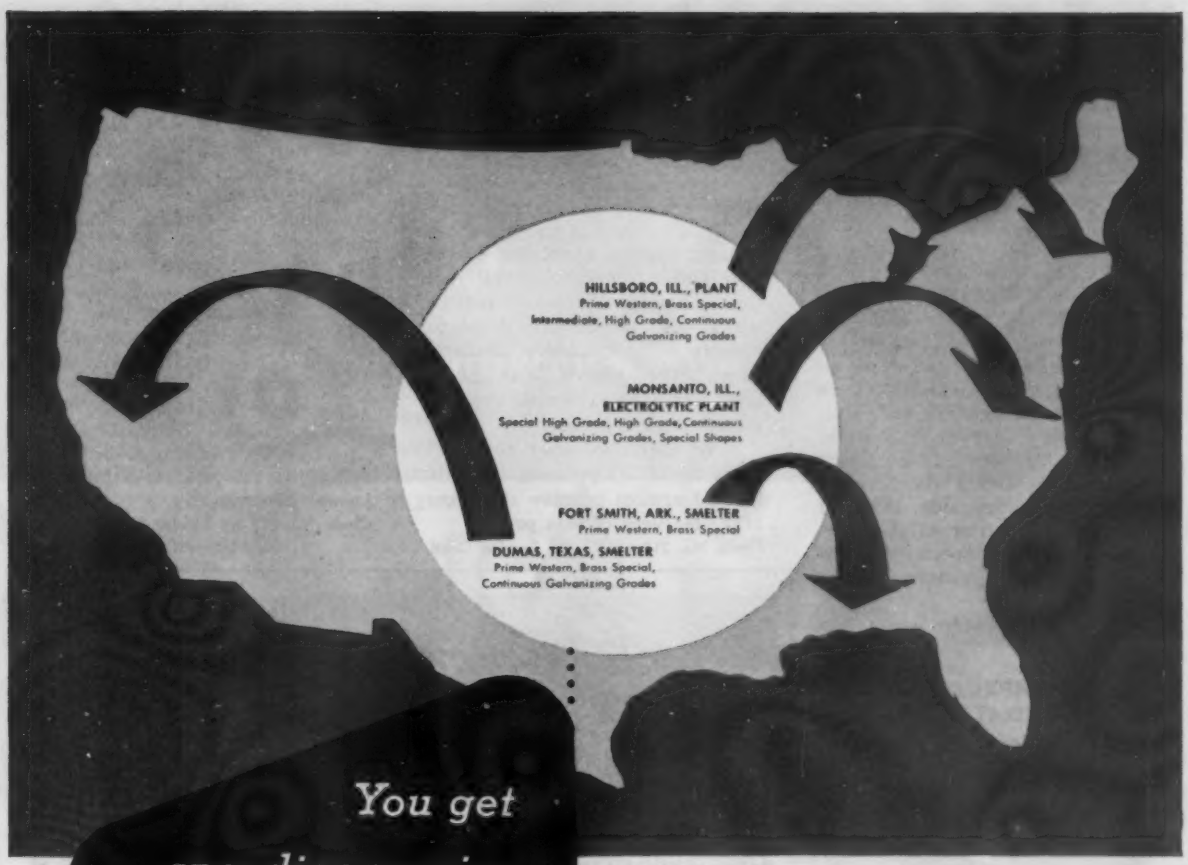
The unit has its own hydraulic load-applying means; and is designed so that different fixtures for different thicknesses of metal can be quickly and easily interchanged.

The tester, developed by Steel City Testing Machines, Inc., is 70" high, occupies a floor space of approximately 18" x 24", has a 15,000 lbs. capacity, and employs a ½ H.P. motor. Two simple hydraulic valves control pressure and directions of piston travel.

When testing a given thickness there is no need to remove any of the fixtures between tests, thereby keeping dies in perfect alignment. As the lower die retracts at the conclusion of a test, an ejection device operates to remove the specimen from the lower die. The operator can just pick it out with his hands after the machine has completed its cycle.

Circle No. 207 on Reader Service Card

Continued on page 74


HILLSBORO, ILL., PLANT
Prime Western, Brass Special, Intermediate, High Grade, Continuous Galvanizing Grades
MONSANTO, ILL., ELECTROLYTIC PLANT
Special High Grade, High Grade, Continuous Galvanizing Grades, Special Shapes
FORT SMITH, ARK., SMELTER
Prime Western, Brass Special
DUMAS, TEXAS, SMELTER
Prime Western, Brass Special, Continuous Galvanizing Grades

You get speedier service from the ZINC ZONE

Central location of American Zinc plants assures prompt deliveries of slab zinc to any point in the nation.

PRODUCERS OF

ALL GRADES OF SLAB ZINC
ZINC ANODES (Plating & Galvanic)
METALLIC CADMIUM
SULPHURIC ACID
LEAD-FREE and LEADED ZINC OXIDES
ZINC CARBONATE
GERMANIUM DIOXIDE
AGRICULTURAL LIMESTONE
CRUSHED STONE

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Distributors for AMERICAN ZINC, LEAD & SMELTING COMPANY

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For more information circle No. 11 on the Reader Service Card

CORROSION INHIBITOR

. . . is effective at low concentration

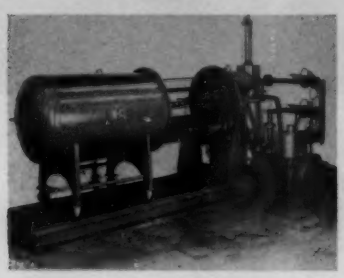
Triethylammonium Phosphate 802, manufactured by Beacon Chemical Industries, Inc., is an effective corrosion inhibitor at low concentration and is suggested as an additive in closed systems where water, glycerine, alcohol, or glycol are used and where corrosion is a problem.

The inhibitor is useful as an ingredient of formulations where water, alcohol, glycol, and glycerine in combinations with other materials are stored in tin-plated and steel containers where longer storage life is desirable; or as an ingredient of water soluble corrosion inhibitors, specialty detergents, emulsion paints, and paint removers.

Circle No. 208 on Reader Service Card

MEDIUM CAPACITY VACUUM COATER

. . . is moderately priced



A new vacuum metallizing unit has been introduced to fill the need for a moderately priced, medium capacity vacuum coater.

Model 3143 Industrial Vacuum Coating Unit, manufactured by NRC Equipment Corp., is useful where the volume of work is insufficient to utilize the capacity of a large production coater.

The unit comprises a 5' long, 42" diameter horizontal coating chamber which provides 12,000 square inches of coating capacity per load. The system will exhaust an empty chamber to coating vacuum in less than 10 minutes. Fully loaded, the unit will process three to five batches per hour.

Circle No. 209 on Reader Service Card

125 TON POWDERED METAL PRESS

. . . now being demonstrated

The Haller, Inc. 6-125 powdered metal press, which will be manufactured by Watson-Stillman, is being run for demonstration purposes in the Haller laboratory.

The press has the following features: Shuttle type filler shoe with stirring device to insure uniform fills. Dual-concentric cylinders for use as not only bottom pressure but for transferring powder into the top of the die. Convenient control panel for operation and adjustment of all motions. Compact construction which does not require a pit to remove lower cylinders. Unitized construction where both press and hydraulic systems are all mounted on one base.

Easy operation, easy changing of fills and all pressing motions located against positive stops are other features of this press.

Circle No. 210 on Reader Service Card

NEW DISINTEGRATING MACHINE

. . . removes broken taps

The new C-1 disintegrating machine, manufactured by Jiffy Disintegrator Inc., provides for efficient removal of broken taps, drills, reamers, studs, etc.

Completely portable, the machine has a meehanite "T" slot work table 25" x 30". The head travels by ball bearing carriage on double track radial arm with finger touch lock and movement control. The gravity automatic feed incorporates a depth control. The unit features a recessed control panel with 5 point tap switch, power, head and pump switches and a 0 to 100 variable autotransformer powerstat.

Circle No. 212 on Reader Service Card

Continued on page 76

Hammond OF KALAMAZOO
GOOD MACHINERY SINCE '82

MODERN Self Contained GRINDER-POLISHER

Hammond Variable Speed (1500 to 3000 RPM) Polishing and Buffing Lathe. Models up to 50 HP available.

Hammond Cyclone Duskolector. One of a wide line of Cyclone and Filter Types.

Hammond Backstands. 10 Air and Spring Tension Models to choose from.

Write for Catalog No. 60 showing America's most modern and complete line.

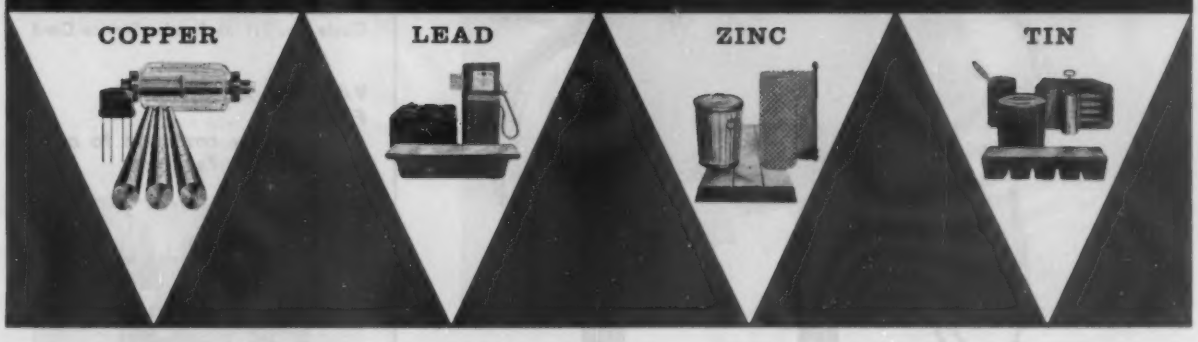
Hammond Machinery Builders INC.
1642 DOUGLAS AVENUE • KALAMAZOO, MICHIGAN

For more information circle No. 89 on the Reader Service Card

with quality and dependability as bywords . . .

AMCO

Serves Industry's Non-Ferrous Needs



For well over half a century, American Industry has found AMCO a reliable and dependable source of high-quality copper, lead, zinc, tin, and other non-ferrous metals.

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Continued from page 74

DIE CASTING FURNACE . . . is a compact unit

A new Radiant Aluminum Die Casting Furnace, which melts and holds all in one compact unit, has been announced by the J. A. Kozma Co. The furnace is fired by radiant cup burners which eliminate flame impingement and localized overheating of the metal.

The design and excellent temperature uniformity provide; a reduction of metal loss, increase in metal quality, faster melting, and greater operator comfort.

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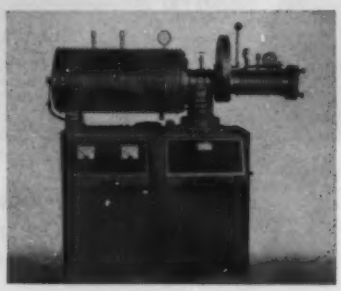
VACUUM ANNEALING FURNACE . . . readily converts to a melting furnace



This new, completely self-contained, vacuum annealing furnace for laboratory or light production, can be easily converted to a melting furnace, so that with one basic unit the user has a complete installation for vacuum processing.

The F1212-2A, manufactured by High Vacuum Equipment Corp., is a double pumped muffle type vacuum annealing furnace with a hot zone of 6″ ID by 12″ long. It is capable of operating continuously at 2150 F. or intermittently at 2200 F. at a pressure of 1×10^{-4} mm Hg, or less. The vacuum retort and cooling chamber are insulated and water cooled.

The unit is converted to a melting furnace, using the same cabinet, power supply, and pumping system, by simply removing the horizontal assembly and substituting a spherical melting chamber with a resistance heated furnace containing a crucible suitable for melting 12 lbs. (steel) at up to 2000 C.

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Continued on page 78

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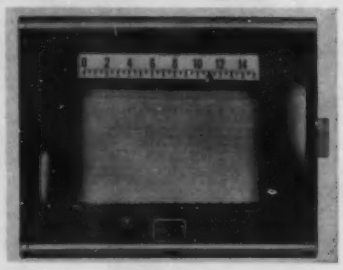
NEW PRODUCTS
continued from page 76

STRIP-CHART RECORDER
. . . automatically plots a continuous curve



A new strip-chart recorder, the Electronic Dynamaster X-Y Recorder, will automatically plot a continuous curve showing the relationship of one measured variable to another.

Typical uses of this instrument manufactured by The Bristol Co., include plotting temperature versus pressure in the process industries, and position of intake parts versus gas flow in wind tunnel research. Other variables can also be handled.

The instrument records on a 12" strip chart, and is available in pen speeds of up to 0.4 seconds for full scale traverse.

Circle No. 217 on Reader Service Card

DRILL & REAMER
. . . is one tool

A new tool has been announced that is a combination drill and reamer. Called the "Dreamer", the tool reduces production costs and operation time, because it eliminates the necessity of two set-ups and double handling in precision drilling and reaming operations.

Manufactured by The Custanite Corp., the tool has been tested in the field for one year. The flutes are ground from solid M-2 ‡662 H.S.S. for greater accuracy. Sizes range from ⅛" to ⅝" in divisions of 1/64".

Circle No. 214 on Reader Service Card

LUSTER BLACK FINISHES ON ZINC
. . . produced by new solution

A new solution, developed by Wagner Bros., will produce deep, lustrous black finishes on either plain zinc die cast or zinc-plated parts in about 10 to 120 seconds of immersion time, depending on the temperature range of the bath.

Circle No. 216 on Reader Service Card

Continued on page 108

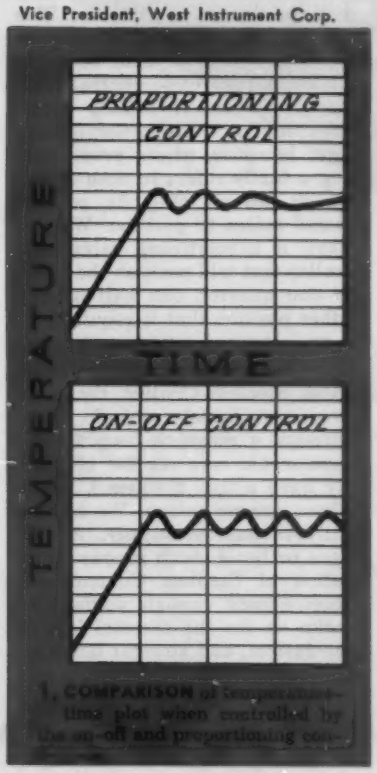
Controlling temperatures in foundries and casting shops calls for accurate checking by using one or more . . .

Ways To Control Temperatures Accurately And Economically

BY WILLIAM C. WEST, JR.

Vice President, West Instrument Corp.

THE selection of a suitable instrument to control a process is often the biggest problem that we face in the field of temperature control. Actually, there are three basic problems involved. First, we must decide on a basic type of measuring system that is suitable. Second, we must determine the degree of control that we desire and the magnitude of the variables that we intend to control. Third, we must find the specific instrument that combines the measuring and control function that we require. Selection of the measuring system itself ordinarily depends on the temperature range that we require, the physical location of the installation in regard to the process, the type of process, the degree of accuracy with which we wish to measure, and of course, the cost.



1. COMPARISON of temperature-time plot when controlled by the on-off and proportioning con-

The filled system thermometers consist of three basic types, vapor, gas and mercury. In these three systems, the measuring instrument is connected by a capillary tube to a bulb located in the process. Expansion of the fluid in the bulb due to an increase in the temperature exerts a pressure in the instrument through this sealed system which is mechanically linked to a pointer or pen.

FILLED THERMOMETERS

Vapor filled thermometers should be used for a range of approximately –40° to 600° F.

Gas filled systems will cover a range of approximatedy –140° F. to 800° F.

Mercury filled systems will covalmost anywhere between –40° F. F. to 1000° F. and have a further advantage in that they exert sufficient force to have a high speed of response and narrow temperature spans. A temperature span as small as 100° F. can be obtained almost anywhere between –40° F. and 1000° F. Basically, these filled system thermometers are very good. They have sufficient accuracy and the cost is very reasonable. Also, they are ideal for certain hazardous locations.

The major disadvantages to these units lie in the fact that the filled capillary tube must connect the sensing unit with the basic instrument, and this frequently gives an installation problem. Also, the bulb and capillary are not usually replaceable in the field, and it is usually necessary to return the instrument to an instrument service organization whenever installation of a new bulb is required. One of the reasons that a thermocouple is often preferred even in these low temperature ranges is because the thermocouple connection is made with wire which is both more flexible and more rugged than the capillary tube and it is only necessary to install a new thermocouple if it is damaged. It is not necessary to recalibrate the entire system.

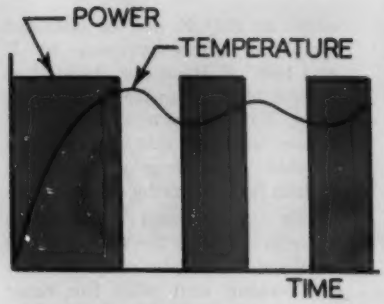
Copper constantan thermocouples are normally used between –300° F. and plus 600° F.

Iron constantan thermocouples are normally used between 0 and 1400° F.

It is evident that these particular thermocouples overlap the same ranges that the thermometers are used for; however, as a thermocouple always works on a difference between its hot and cold junction, it is usually not suitable for temperature measurement close to ambient temperatures.

RESISTANCE THEROMOMETERS

The resistance thermometer measures the change in a resistor through a bridge circuit and has the advantage of the ease of installation of the thermocouple and the accuracy and low temperature operating advantages of a filled system thermometer. The resistance thermometer is usually, however, more expensive than either the thermocouple combined with a millivoltmeter pyrometer or the filled system thermometer. The filled system thermometer can be constructed as a recording instrument rather economically. The resistance thermometer and the thermocouple can be combined with a potentiometer recorder and provide extreme accuracy;



2. ON-OFF controller action as it brings a furnace up to a set temperature, then maintains the same temperature for a certain period of time.

however, the cost is usually greater than the filled system.

THERMOCOUPLES

Chromel alumel thermocouples are normally used in a range of from approximately 600° F. to 2100° F. occasionally to 2400° F.

Platinum thermocouples are usually used only for the higher ranges up to approximately 2800° F. Radiation pyrometers are used above this range and for many uses below this range. The thermocouples, resistance thermometers and radiation pyrometers can all be used with either a millivoltmeter or a potentiometer.

OPTICAL PYROMETER

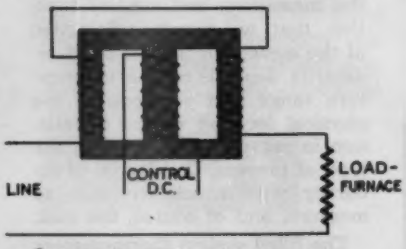
Optical pyrometers are frequently used to measure a temperature in the high range by sighting directly on the object that is to be measured. The optical pyrometer is designed for measuring only.

We have completed our consideration of the basic measuring system for any range of temperature from minus 300° on up to approximately 7000° F. Now we must consider control.

CONTROLS

Control in the filled system thermometer is ordinarily accomplished through some form of mechanical linkage between the control and the measuring system. This is easily possible as the thermometers develop sufficient torque. In millivoltmeter instruments we do not have sufficient torque in the millivoltmeter to make mechanical control directly with the indicating pointer without somewhat affecting the accuracy of the system. Where the small loss in accuracy can be tolerated, we can use mechanical contact millivoltmeters. Usually, the mechanical types are small and compact and cost less than those not contacting millivoltmeters. If greater accuracy is desired, then it is necesary to transmit the control signal from the indicating pointer to the control point by some electrical means such as by use of a flag on the indicating pointer interrupting light falling on a photocell at the control point. In a potentiometer instrument the signal from the thermocouple is balanced against a standard signal and any unbalance is fed through an amplifier to operate a servo system which re-sets the standard signal to match the thermocouple signal. The basic design of a potentiometer makes it a more accurate measuring device than a millivoltmeter because a millivoltmeter is always drawing a current or consuming some of the signal. The potentiometer draws no current when it is balanced, so we are not actually consuming any of our original signal. Of course, the potentiometer is a more expensive instrument.

Now that we have established

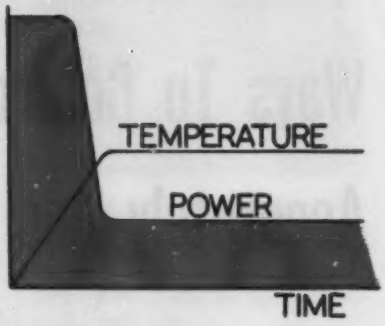


3. MODULATED power input to a furnace is provided by a stepless controller which uses a saturable reactor. Direct current control signal from the pyrometric instrument varies the line-power without using relays or contactors.

the basic types of instruments that can have controls combined we need to consider the basic types of control in order to completely answer our problem.

Off-on control is the simplest form of control. We are either turning a heater off and on or opening and closing a valve. This is sufficient control of temperature for a great many processes. It may be, however, that too much over or undershoot is present and that a refined control is required. The next step would be proportioning or combining a time on and time off function in such a way as to anticipate the temperature needs and shut off sooner. Ordinarily, the off-on cycle of a proportioning controller is much less than the straight off-on control and considerably less oscillation of the temperature will occur (See Fig. 1).

Occasionally, the off-on principle of control is combined so that we have a three position controller. This is frequently used



4. STEPLESS controller brings the furnace up to a certain temperature and keeps it there. When maintaining a furnace-temperature with the stepless controller, a point will be reached where the power input continuously balances out heat losses in the system.

with a floating motor to control a valve. In one position the valve will open, in the center position it will stand still and in the other position, the valve will close. This can also be used for high, medium and low limits of heat so as to obtain a very close control. Proportional control sounds somewhat similar to proportioning control; however, where proportioning actually refers to time of full on or full off (Fig. 2), proportional refers to position. We can have a proportional valve controller that will position the valve at one quarter, one half or any other position that is required.

The ultimate in control of electrical heater loads is often referred to as Stepless Control. By coupling our initial control signal through a magnetic amplifier to a saturable core reactor (Fig. 3) we have a true Stepless Control. There are no relays. We have a fully modulated supply. A furnace or heater with proper application of Stepless Control will receive only enough wattage to make up for the thermal loss of the system, and straight line control results. (See Fig. 4).

We now have the basic data that we need to select our control for our process.

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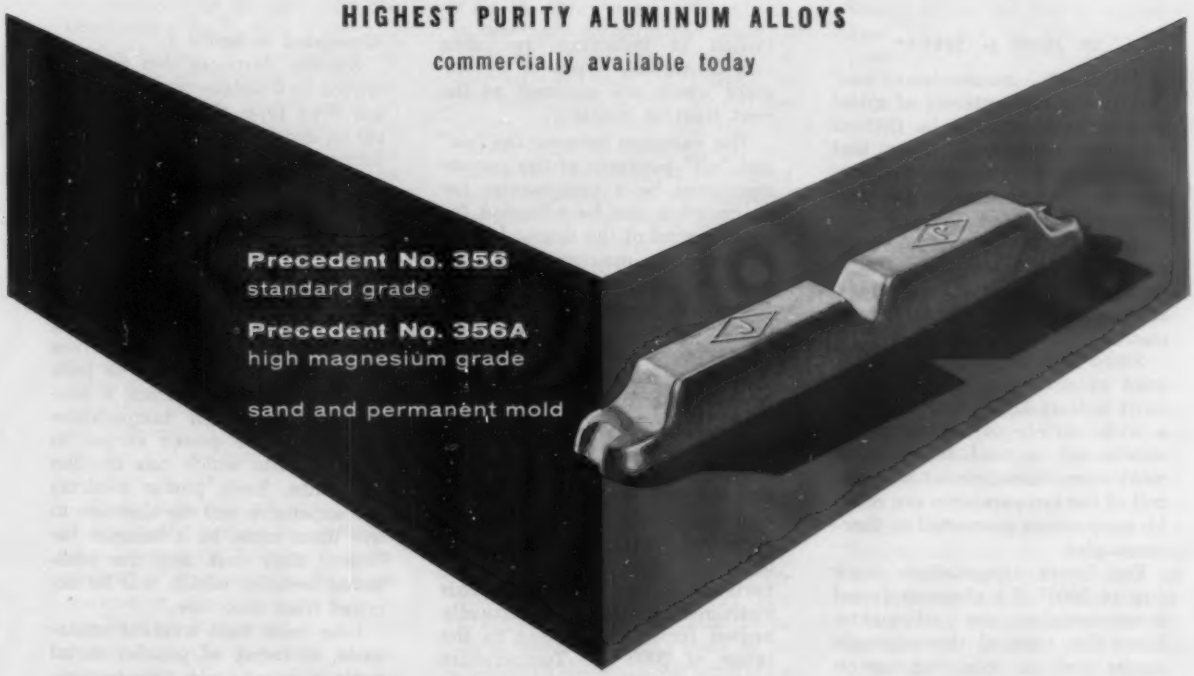

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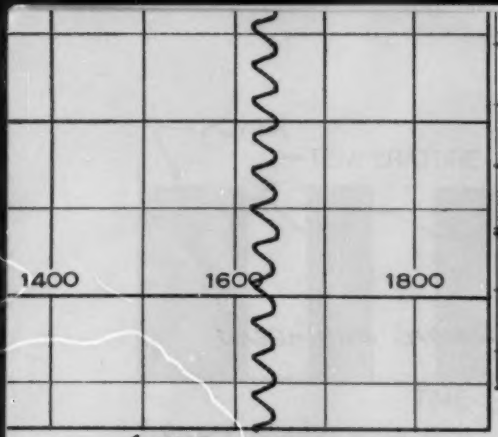
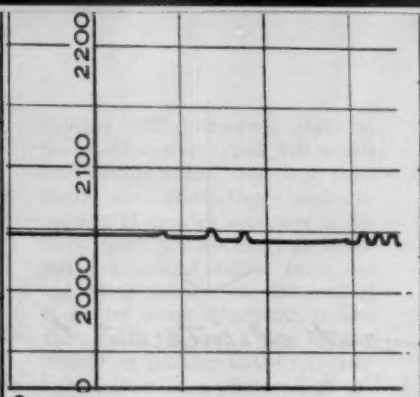
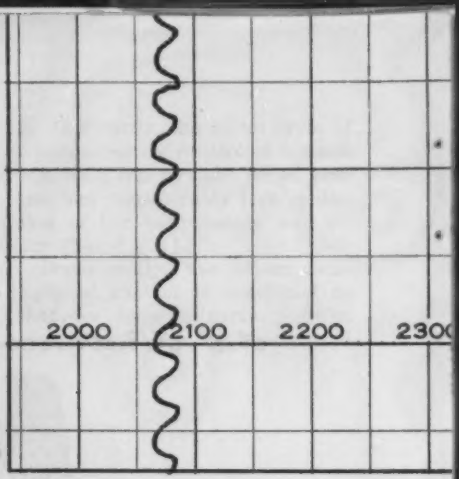


1. **HEAT** variations on gas furnace sintering bronze contacts.



2. **STEPLESS** type of control gives uniform heat pattern seen here.



3. **ELECTRICALLY** heated furnace gives this temperature pattern.

Controls Used In Powder Metallurgy

BY JOHN H. SPECK*

CONTROL mechanisms used during the sintering of metal powder products can be divided into two categories. Those that are used on the sintering furnaces and those used on the gas generating equipment.

In turn the furnace controls may be further subdivided into four groups, viz: 1. Temperature, 2. Powder, 3. Time, 4. Atmospheres.

Since the temperature range used in sintering metal powder parts is from 1200° F. to 2650° F., a wide variety of control mechanisms can be used. However, in most cases measurement and control of the temperatures are made by pyrometers connected to thermocouples.

For lower temperature work (up to 2000° F.) chromel-alumel thermocouples are adequate. Since this type of thermocouple works well in oxidizing atmospheres, it can be employed in gas fired furnaces where it is exposed to the products of combustion. For higher temperatures the platinum-platinum rhodium thermocouples are standard equipment. In these higher temperature ranges the furnaces are generally electrically heated, and the thermocouple extends into the sintering chamber. Also the atmospheres used at these higher temperatures consist of the endothermic type which makes the chromel-alumel thermocouples unsatisfactory.

These thermocouples are attached to indicating recording and controlling types of pyrometers which are common to the heat treating industry.

The variation between the "on" and "off" positions of the pyrometer must be a compromise between what can be tolerated for good control of the finished product and the maintenance upon contacts and valves which are continually opened and closed by the pyrometer. An example of one type of instrument control is shown in figure 1. The variation between the high and low is approximately 20° F. This is used on a gas heated furnace sintering bronze compacts. In this operation the temperature variation of such magnitude can be tolerated. A second control is illustrated in figure 3. Here the temperature variation is less than 20° F. This instrument controls an electrically heated furnace operating in the range of 2000° F. Temperature variations of the same magnitude as shown in figure 1 can be sufficient to cause excessive dimensional variation in the sintered part.

The heat in a gas fired furnace is controlled by a motorized valve on the air supply line. This valve is opened and closed by the response of the furnace thermocouple to the load of cold stock entering the furnace. With the thermocouple being placed outside of the actual sintering chamber the response of the rise and fall of heat is not as rapid as that of the electric furnace. This is shown on the pyrometer chart illustrated in figure 1.

Electric furnaces can be controlled in a similar manner to the gas fired type, that is, by a simple on and off cycle of the heating current. However a stepless type can be employed that gives a more uniform heat. This type of control is illustrated in figure 2.

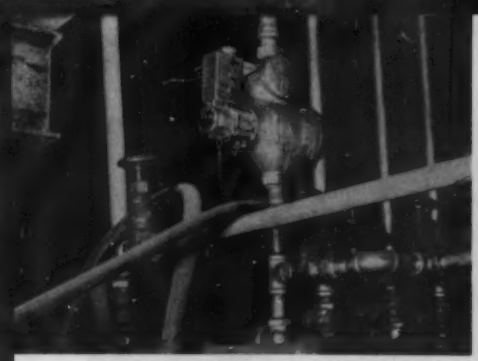
The saturable reactor acts as a valve to regulate the power input to the furnace. It varies the power applied to the heating units, responding to temperature changes before they can be indicated on the chart. Such a control gives an even temperature and eliminates power surges to the elements which can shorten their life. Such power controls are expensive and the decision to use them must be a balance between their cost and the additional benefits which will be accrued from their use.

Like most heat treating operations, sintering of powder metal parts is based upon time-temperature relations. Likewise since the economy of powder metallurgy is based upon mass production, methods to control the time in the furnace have an importance equal to that of temperature control.

In the belt or roller hearth continuous type furnaces, the speed of the belts or rolls can be controlled through the familiar variable-speed pulley drives. Such types give enough variation in the speed to cover the wide range of parts being sintered.

In pusher furnaces the load can be cycled by the actuation of hydraulic circuits controlled by

*Chief Metallurgist
Amplex Div., Chrysler Corp.



4. FLOWMETERS used to control the amount and consistency of the atmosphere fed to the furnace. When atmospheric blend is being used, these instruments regulate it.

clocks or alarm systems to indicate to the operator when a new charge is ready. Most sintering is done in the continuous belt type units since they offer the most economical rate of payload to conveyor for the average sintered metal parts.

The control of atmosphere in the sintering furnace is mainly concerned with maintenance of the proper volume and mixture to insure the quality of the finished part. Figure 4 illustrates the use of flowmeters to control the amount of atmosphere fed to the furnace. If a blend of more than one type of atmosphere is to be used, the ratio of the two can be regulated through these units. If the stock fed to the furnaces is going to vary in height, the atmosphere pressure in the furnace will vary when the door is raised or lowered. A pressure sensing device will increase or decrease the flow of gas.

Since virtually all metal powder sintering is done in controlled atmospheres, it follows that the control of the variables is as important in this phase as it is in the furnace treatment.

Although the types of atmospheres that can be employed are numerous, general practice in the field has limited it to four common types.

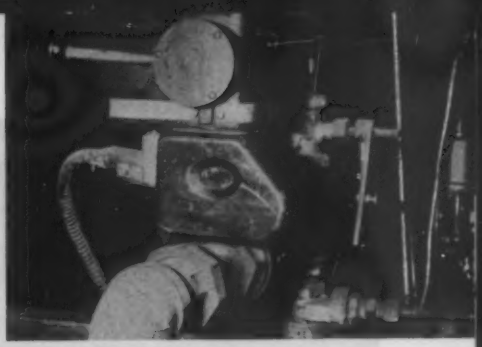
For non-ferrous (copper and bronze) work the exothermix type is common. The air-gas ratio is approximately 5 to 1. This ratio can be maintained by the simple use of orifices in the intake lines. The temperature of the reaction is maintained by the combustion of the gas and thus need not be subject to exterior control devices.

Endothermic types of atmospheres which have a more pronounced effect upon the sintering results must be more closely regulated to produce the desired results. The air-gas ratio here can also be maintained by use of orifices. The production of this type of atmosphere is more dependent upon temperature than is the exothermic type. Here again the pyrometer controllers as used on the furnaces are employed. The indicating pyrometer prevents overheating of the combustion chamber should the temperature pyrometer fail. If such a failure should occur the temperature in the combustion chamber could increase to such a point where the alloy reaction vessel would melt. The expense incurred for installing such a safety device is relatively little in comparison to the cost of a high alloy retort.

Air-gas ratio and temperature controls are not sufficient in many cases to main the satisfactory quality of the atmosphere desired. A case in point is the production of the iron-carbon alloys. The CO_2/CO and H_2O/H_2 ratios must be determined and controlled to prevent excessive decarburization of the sintered compact. While many automatic devices are on the market, their cost is generally too high to consider their use. The gas analysis as determined on a common Orsat type analyzer is accurate enough to produce the desired results. Daily checks of the generator output plus analysis of the atmosphere inside the furnace chamber are necessary to maintain the proper equilibrium.

An additional method of maintaining the proper atmosphere is using three flowmeters to meter the proper proportions of (1) endothermic carrier gas, (2) natural gas, and (3) ammonia. These three gases are being used as atmosphere during a carbontriding operation.

Simple analysis alone of the atmosphere is not a complete enough regulation without the inclusion of methods to lower and measure the dewpoint of the gas.



5. VALVE to shut off furnace-atmosphere when temperature falls.

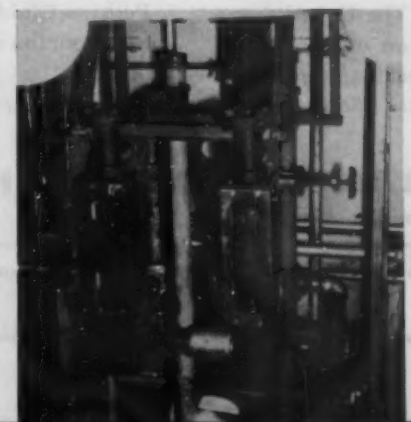
Reduction of the water content is accomplished by passing the gas through a tower filled either with activated alumina or silica gel. When these absorbent materials are saturated the gas is switched to the second of the two towers while the first is regenerated. The size of the towers is predicated upon the amount of gas to be treated and upon the degree of dryness desired.

The use and production of dehydrated atmospheres is somewhat impractical unless some means is taken to measure the moisture contained in them. Automatic means are available to measure the moisture content of gases, but here again a compromise must be made between the cost and good derived from such an expenditure.

With the large volume of explosive gases being used in the powder metallurgy field, some mention should be made of safety devices available. Figure 5 illustrates a valve used to shut off the supply of atmosphere gas to a furnace should the temperature drop below a specified value set by Factory Mutual Underwriters. This valve is connected to the furnace pyrometer which trips a switch if and when the temperature drops below a set value.

Figure 6 shows a safety valve used on hydrogen or dissociated ammonia supply lines. This device shuts off the gas supply in case of a flashback in the furnace chamber.

Just as the science of metallurgy grew from the art of blacksmithing by the application of controls, so also do the many controls described and illustrated here give powder metallurgy an added stature in the vital field of metal fabricating.



6. SAFETY valve for supply lines of H_2 or dissociated ammonia.

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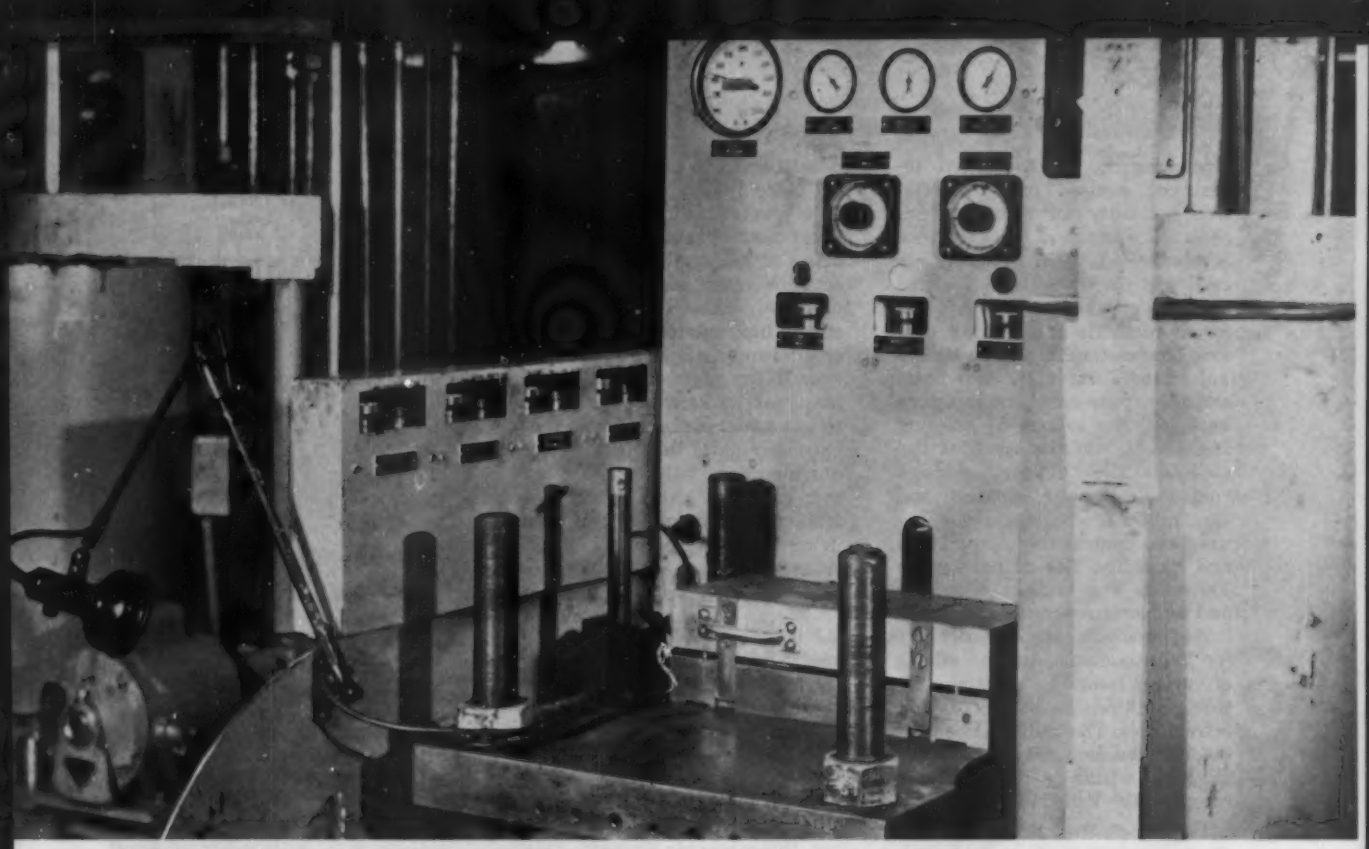

1. WAX MACHINE which controls temperatures within a range of ±3°F by means of the three thermostats seen on the machine's back panel. Four thermostats on the left side of the machine control temperatures of the top and bottom platens of the mold clamping press. Two for heat, two for cooling.

Heat Control of Investment Casting

BY S. C. TINGQUIST* & WILLIAM CUDDY**

PRODUCING castings of consistent quality by the investment casting (lost wax) process requires considerable control throughout the process. A number of variables that affect quality and dimensions of the casting must be controlled to close tolerances in order to obtain reproducibility. Temperature is one important variable that must be controlled on several operations.

No attempt will be made to cover all temperature controls required but only to point out a few of the more critical operations that require temperature control, what type of control is required, and a means of achieving this control. Those familiar with investment casting know that the process involves producing a wax pattern, mounting wax patterns into an assembly, dipcoat and invest wax assemblies, eliminating the wax from the prepared mold, heating the mold and casting into this preheated mold.

*Mgr., Process Research, **Instrument Service Technician, Austenal, Inc.

The wax patterns used in investment casting are made by using injection machines which inject a heated wax into a mold which contains the desired pattern cavity. Accurate temperature control is necessary throughout the injection process. The wax in the machine storage tank and pressure system must be kept at a temperature for the right viscosity for injection in order to completely fill out the mold cavity without faults. Too high a wax temperature results in shrinkage on heavy sections and increased length of time required to cool and solidify the wax in the mold before it can be removed. If the wax temperature is too low, an unfilled pattern without sharp corners or with folds on the wax surface will evolve. Figure 1 is a photograph of one of Austenal's wax machines. Wax temperature is controlled within a range of ±3° F, at three locations by the three thermostats on the back panel of the machine. The top and bottom platens of the mold clamping press have their temperatures controlled by the four thermostats on the left side of the machine. Two thermostats are used for heat control and two for cooling control, depending upon the requirement of heating or cooling of the mold.

Waxes have a relatively high coefficient of thermal expansion and are easily distorted with an increase in temperature. Variations in ambient air temperature are sufficient to cause distortion in a wax pattern and have appreciable effect on dimensions. Because of these problems, Austenal has found it advisable to do their wax storage, wax setup and investing of the setups in a temperature controlled room. In order to control drying and setting time of the refractories used for

dipcoating, or in the mold investment, a close control of relative humidity as well as temperature is required. Temperature is controlled with standard air conditioning units and thermostats in conjunction with two different methods of humidity control. One method cools the incoming air to a very low dew point and then puts sufficient moisture back into the system by blowing live steam into the room at the air inlets. The other method blows cooled air through a dryer and then mixes it with warmer make-up air to control the temperature and humidity. The unit shown in Figure 2 is a walk-in humidity and temperature control box used in Austenal's Research Laboratory for investigations into the effects of various humidity and temperature conditions on the waxes and refractories. The unit will control the relative humidity from 40% to 95% within a temperature range of 70° F to 110° F.

The completed invested mold must be dewaxed, burned out, and preheated for casting. One of the most important considerations in this part of the process is a controlled application of heat to the mold to minimize stresses that fracture the refractory.

The mold processing is usually accomplished by using a tunnel furnace that has zone control. A typical furnace may be 50′ long with six temperature control zones, each zone being controlled by thermocouples in the furnace connected to control pyrometers. As molds are pushed through the furnace they are gradually raised to a firing temperature and then soaked at this temperature long enough to reach proper temperature and obtain complete burnout of any wax residue. Incomplete burnout of wax will produce gas when metal enters the mold cavity, causing defective castings.

The temperature gradient and cycle required for a particular size mold and mold material is achieved by passing test molds through the mold heating furnace. These test molds have thermocouples attached inside and at the top and bottom. Temperature readings on all thermocouples are recorded throughout the cycle as the molds are pushed through the furnace. A curve of the results can then be plotted and adjustments made to give the best cycle.

Casting at the proper metal temperature is one of the more critical steps in any casting process. It is particularly critical in the investment casting process because of the small parts and thin sections often involved. A mold cast with metal too cold will result in incompletely filled castings or unsound castings due to shrinkage. If the metal is too hot, we may get surface shrinkage due to hot spots, surface reaction, etc. On many parts the metal temperature must be held to a very narrow range to avoid casting defects. Common methods of measuring metal temperature are:

1. Optical Pyrometers
2. Platinum-Platinum Rhodium Thermocouples
3. Radiation Pyrometers

Optical pyrometers are used by Austenal primarily as a quick check on the temperature of the metal in a furnace to determine if the metal is approaching the desired temperature.

The Platinum-Platinum Rhodium thermocouple is used in air induction melting work where easy access to the molten metal can be made and where the metal temperature does not exceed the limit of the thermocouple.

The radiation pyrometer has been adopted by Austenal for measuring metal temperature in their arc melting and also vacuum induction melting. Some of the reasons for this choice are: ease of operation, the speed of response, reliability, eliminating the human factor of the optical pyrometer, and low cost.

Figure 3 shows one in use checking metal temperature in an arc furnace pot. The tripod accurately positions the pyrometer head over the pouring spot during the reading. The strip recorder, visible in the upper left hand corner of Figure 3, is used to indicate and record the temperature reading. The lights on top of the cabinet are used to aid the melter and reduce error. They are connected into the instrument in such a manner as to show a green light when the temperature is within ± 5° F of the setting. A white light shows when the melt is 5° F or more below the temperature setting, and a red light shows when the melt exceeds 5° F above it.

Since obtaining the proper metal temperature for casting is critical, it is extremely important that the radiation pyrometer or means of measuring is checked and kept accurate. To reduce to a minimum the possibility of error due to measuring, Austenal has installed a practice of checking the radiation pyrometer as a daily procedure and has provided a special furnace for this purpose. This is a globar heated unit which has a 3″ hot spot target on which to sight the radiation pyrometer head. The temperature of the hot spot is recorded by a Pt-Pt/Rh thermocouple embedded in the refractory. The Pt-Pt Rh thermocouple is checked twice a month against a working standard, and this is checked quarterly against a Bureau of Standards Certified Thermocouple.

2. HUMIDITY and temperature control box of the walk-in type.

3. RADIATION PYROMETER seen checking metal-temperatures.

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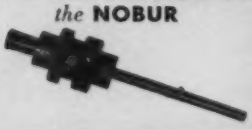

for machine deburring and chamfering of line-drilled and otherwise inaccessible hole surfaces.

for the automatic deburring and chamfering of front and back hole faces simultaneously in sheet metal, etc.

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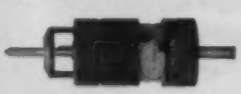

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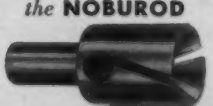

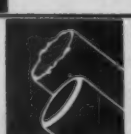

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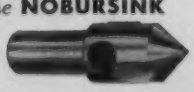

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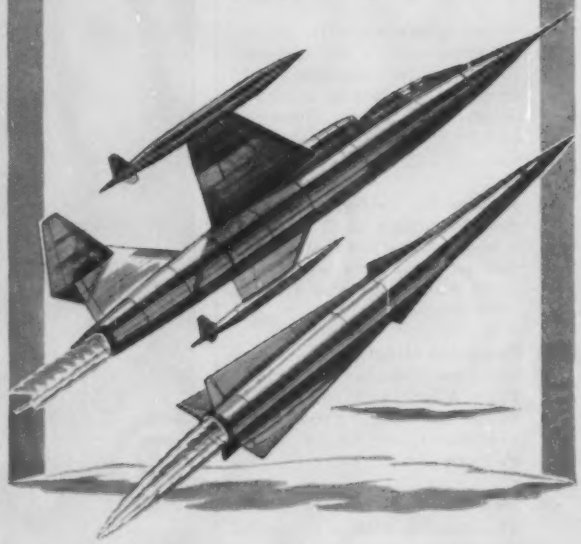

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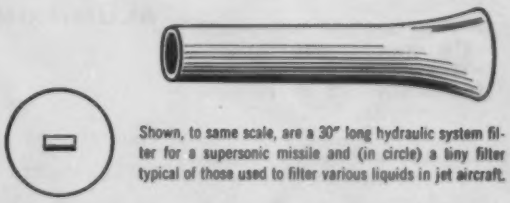

Shown, to same scale, are a 30" long hydraulic system filter for a supersonic missile and (in circle) a tiny filter typical of those used to filter various liquids in jet aircraft.

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AD. LIT.—cont.

68. Plaster Mold Castings—A new brochure from Ohio Precision Castings, Inc. contains interesting information on economical production of small parts.

69. Piston Lubricator—The Dorsey automatic piston and cylinder lubricator for aluminum cold chamber die casting machines is described in an illustrated folder from Westbrook Mfg. Co.

74. Vacuum Die Casting—Information is available on "Vacufeed"; a new vacuum die casting system for aluminum which features fully automatic feeding, from Reed-Prentice Corp.

75. Powdered Metal Parts—A new brochure, "How to Cut Precision Parts Costs with the Remet Powdered Metal Process", is available from Reese Metal Products Corp.

76. Iron Powder—Information on iron powder with a controlled dimensional factor, "CDF", is available from Republic Steel Corp. The bulletin shows how the company's product has predictable dimensional characteristics after sintering operations.

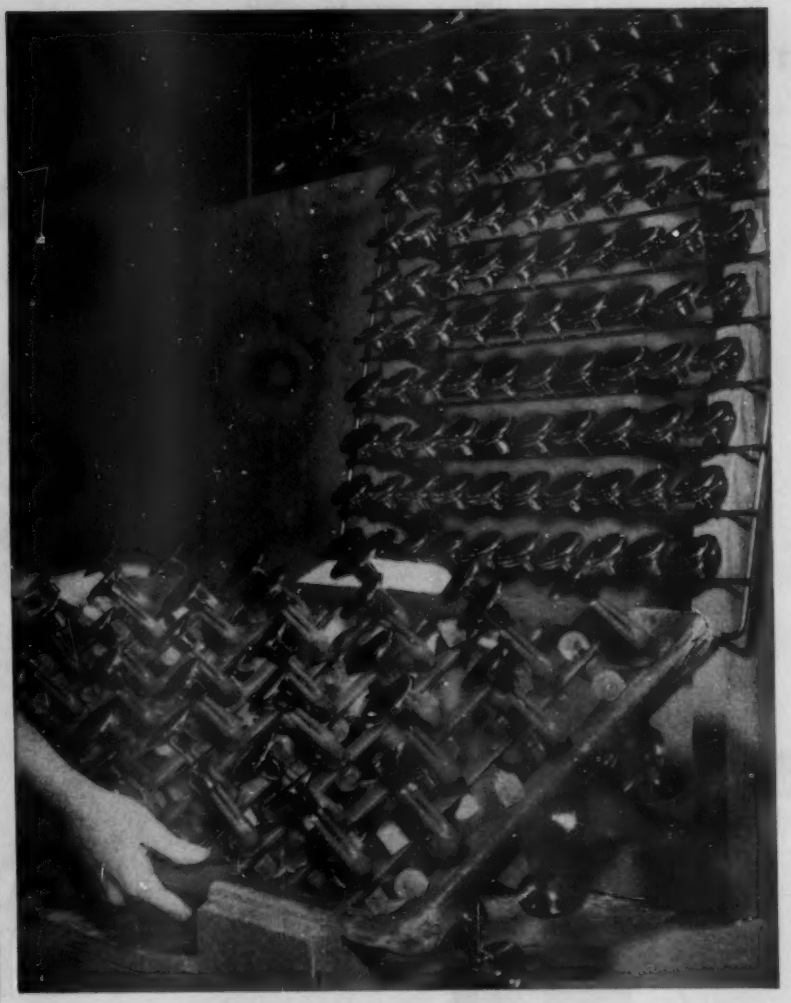
77. Die Cost Savings—Data sheets, available from Richards Tool & Mold Co., describe savings of up to 70 percent on zinc and aluminum die castings with the use of standard "Master Mold" cavity blocks.

78. Investment Castings—Complete information is available on how you can save time, trouble, and expense when you want investment cast ferrous or nonferrous parts. Scott Castings, Div. of Rolle Mfg. Co.

79. Stainless Steel Ladles—and skimmers for non-ferrous metals are listed in data from Spincraft, Inc. Sizes in stock and prices are included.

81. Conveyor Belting—Metal conveyor belting that is made of link chains, and will operate in high or low temperatures, is described in literature from Stroman Furnace & Engineering Co.

82. Fire-Resistant Hydraulic Fluids—are discussed in the booklet, "Ucon Hydrolubes Spell Safety", from Union Carbide Chemicals Co. The results of laboratory tests and actual service records are presented along with information on the ease of conversion to these fluids.



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84. Pilot Plant Facilities—A new booklet issued by Westinghouse Electric Corp., entitled "For A Competitive Edge", describes their new metals plant at Blairsville, Pa.

44. Zinc Base Alloys—The new Zamak zinc base alloys reference book and guide offers technical data to die casters and engineers. Henning Bros. & Smith.

98. Investment Casting—engineering and design manual deals with surface finish, hole sizes, parallelism, straightness, etc. This new manual is available, one to a plant, by writing on company letterhead to Engineered Precision Casting Co., Freehold Rd., Matawan, N. J.

103. Contact Wheel—A new sectional rubber contact wheel that shapes itself to the work piece is described in informative literature from the Chicago Rubber Co., Inc.

108. Mold Materials—Technical information is available on mold wash materials, ceramic molding media, shell molding minerals and other products of Harbison-Walker Refractories Co.

12. Aluminum Alloy—designed especially for die casting is fully described. Included are complete specification sheets on the as-cast properties of alloy Z-39 from Apex Smelting Co.

37. Die Profiler—The Di-Profiler reciprocating hand machine for precision die making and maintenance is described in literature from the Hyprez Div., Engis Equipment Co. Price List DV 117.

L. W. HOUY JOINS METALS DISINTEGRATING CO., INC.

Leslie W. Houy

Harold E. Collins, vice president of Metals Disintegrating Company, Inc., announces the appointment of Leslie W. Houy as sales representative of its metal powders division and alloys division products on the West Coast.

Mr. Houy will make his headquarters in Huntington Park, Calif.

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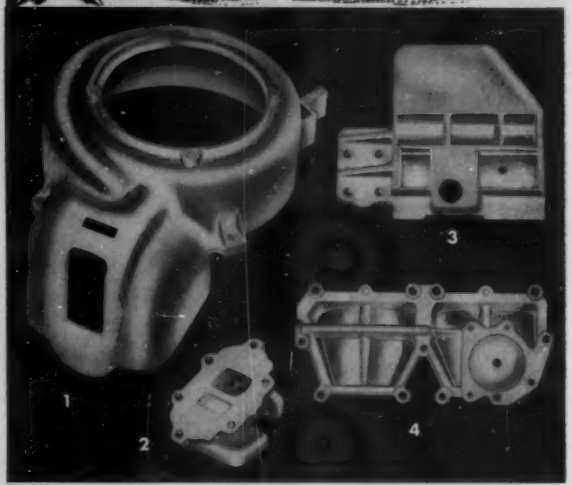

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TABLE I
PORE COUNTS IN SURFACE AREA OF 0.0293 cm² AFTER SINTERING COPPER POWDER COMPACTS AT 1000°C FOR 1 HOUR AND 100 HOURS RESPECTIVELY. (POROSITY OF "GREEN" COMPACT 44%.)

(according to Rhines and co-workers)

Sintering Atmosphere	Time, hr.	Porosity %	Pore diameter in mm. 0.034	0.025	0.017	0.012	0.009	0.006	0.004	0.003	Smaller
Hydrogen	1	23	0	15	65	413	1397	2987	2340	1415	1189
	100	9	7	44	93	293	769	824	514	392	314
Argon	1	21	0	0	6	104	503	620	1361	1605	1908
	100	15	0	3	172	210	553	676	672	718	687
Vacuum	1	15	0	6	32	74	145	281	351	805	1509
	100	6	3	12	40	123	181	425	923	1044	833

Vacuum Sintering – Part II

By HENRY H. HAUSNER*

THE green metal powder compact contains a large number of voids, the total number and volume of which are determined by the powder particle size and shape, the plastic deformation of the particles, and the pressure applied during compacting. During sintering, the total pore volume decreases, the compact shrinks, and densification occurs.

EFFECTS OF SINTERING ATMOSPHERE ON POROSITY AND PORE MIGRATION

It is well known that sintering affects the porosity in the following way: (a) The total number of pores decreases progressively during sintering at all temperatures. (b) The average pore size existing in the compact increases with the time of sintering. (c) There is, for each condition of sintering, a pore size which occurs in maximum number in the size scale, and this maximum shifts towards larger pore sizes as sintering proceeds. (d) Late in the sintering process there exist pores which are larger than any present at the beginning.

These facts, shown in Fig. 1, are independent of whether sintering occurs in a reducing or neutral atmosphere, or in vacuum.

*Vice Pres., Nuclear Eng. Div., Penn-Texas Corp.

In their extensive studies on the behavior of pores during sintering of copper compacts, Rhines and coworkers made a careful pore count. Their experiments show that the above statements concerning changes in porosity during sintering are correct, and have also resulted in actual figures.

For these experiments very slightly surface-oxidized copper powders of –200 mesh size (max. percentage at 40M diameter) were compacted at 12,700 psi and sintered between 800° C and 1000° C for 1 to 100 hr. in hydrogen, argon, and vacuum, respectively. A few data of Rhines and coworkers' experimental work are shown in Table I, and concern compacts sintered at 1000° C for 1 and 100 hrs., respectively, in the three above mentioned sintering atmospheres. These data indicate clearly that: (a) Sintering in vacuum results in a minimum porosity. (b) The vacuum-sintered compacts have the maximum number of fine, and a minimum number of coarse pores, whereas the maximum number of pores of the hydrogen-sintered compacts lies in the pores of medium size.

These experiments show clearly that vacuum-sintering not only affects the density and total porosity, but especially the distribution of pores of various sizes throughout the sintered compact. We also know today that the pore size distribution determines the grain structure of the sintered

TABLE II
CONTACT ANGLE AND SURFACE TENSION OF NICKEL AT 1500°C

Plaque	Vacuo τ	Vacuo θ (deg.)	Hydrogen Atmosphere τ	Hydrogen Atmosphere θ (deg.)	Helium Atmosphere τ	Helium Atmosphere θ (deg.)
ZrO_2	1730	118.1	1555	130.7	1500	120.3
ThO_2			1540	131.5	1520	134.3
Al_2O_3	1760	128.2	1590	133.4	1505	140.7
BeO	1680	128.3	1595	152.0	1370	146.0
MgO	1600	132.1	1730	152.3	1625	132.1
TiO_2	1165	104.7	1320	143.1	1110	120.6
Be_2C		92		90		75

compact, and may conclude that sintering atmosphere affects grain structure directly.

THE INFILTRATION PROCESS

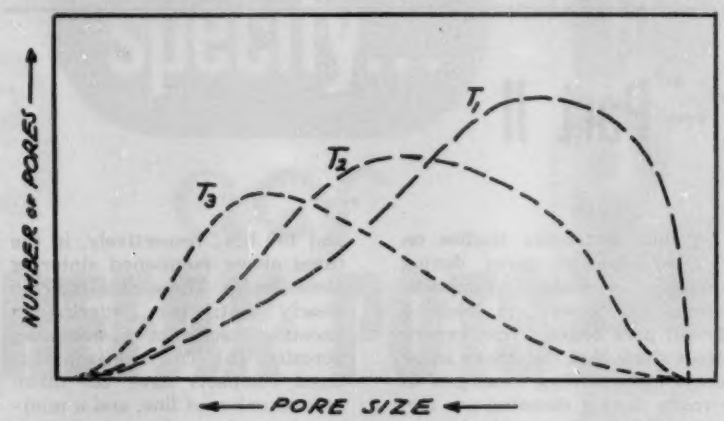
The application of vacuum in the powder metallurgy infiltration process should be mentioned briefly. This process, which refers to the fabrication of a two-component material by infiltration of one component into a porous compact of the second component, is steadily increasing in importance. Copper-infiltrated iron powder compacts, characterized by high density and high strength, are used extensively. To fabricate such parts, porous iron compacts are made, and the molten copper penetrates the pores by capillary forces. In order to obtain complete penetration of the molten copper into the iron skeleton, the process requires application of vacuum techniques.

METAL CERAMIC COMBINATIONS

Vacuum sintering is also of importance in the fabrication of metal-ceramic combinations, known as cermets. The reactions occurring between the metal and ceramic powder particles have a certain similarity to that in the multi-component metal powder systems. Basic distinctions between four different combinations of metal and ceramic components are as follows: (a) Formation of continuous interlocking phases of the metallic and ceramic component. (b) Dispersion of the metallic component into the ceramic matrix. (c) Dispersion of the ceramic component into the metallic matrix. (d) Interaction between the components.

TABLE III
WORK OF ADHESION IN VARIOUS CERMET-SYSTEMS

Metal	Ceramic	Work of Adhesion (erg/cm²) Hydrogen	Helium	Vacuo
Silicon	Al_2O_3	670	580	—
	ZrO_2	730	650	—
	MgO	590	675	—
	BeO	760	560	—
	TiO_2	—	520	—
	Be_2C	1200	1100	—
Nickel	Al_2O_3	480	340	670
	ZrO_2	540	745	920
	MgO	197	600	530
	BeO	187	233	640
	TiO_2	264	595	850
	Be_2C	1100	1400	1100



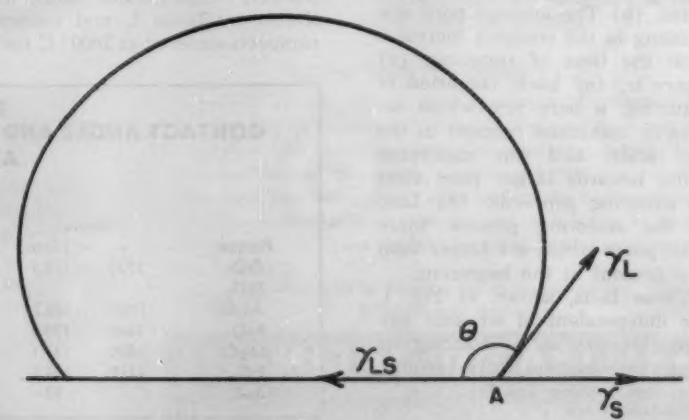
1 **EFFECT** of sintering temperature "T" on pore-size, and on the number of pores (T_1 T_2 T_3), is seen in the graph lines on the chart above.

The physical properties of various types of cermets depend on the type and amount of the components, on the reaction and type of bond, which in itself depends on the sintering conditions, and especially on the sintering atmosphere.

One of the most important factors in the selection of metallic and ceramic components in cermets is their bonding behavior. Extensive studies in this respect were made by Williams and Murray, who distinguish between "surface interaction" and "bulk interaction" in bonding. In cermets of the oxide-metal type, for example, these investigators differentiate three forms of surface interaction: macro-wetting, solid wetting, and wetting assisted by direct lattice fit.

In the case of macro-wetting of the ceramic by the metal, the component's raw materials would be either a mixture of ceramic and metal powders with a particle size in the order of 1 to 10 microns, or a porous ceramic material with metal in the molten state infiltrated into the compact. Macro-wetting will occur at or near the melting point of the metallic component provided that interfacial energy conditions favor wetting. Solid wetting or the dispersion of the ceramic particles by the metal in the solid

Continued on page 94



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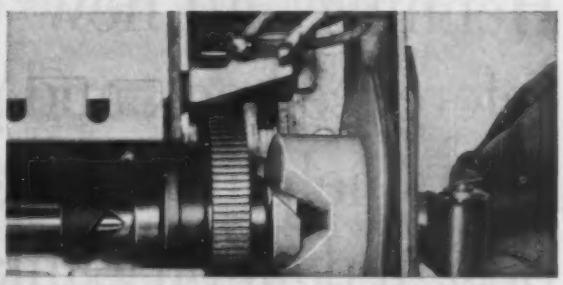

Detail of the Clutch Assembly on Western Electric's signaling generator. The Bar Coupling turns the Nylon Cam which pushes the Clutch Coupling forward to engage the drive gear.

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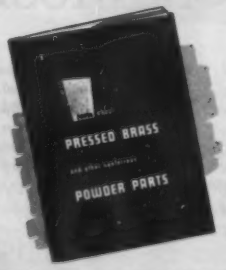

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VACUUM SINTERING

continued from page 92

state will occur appreciably below the melting point of the metal. The metal could be produced in the form of fine powder particles. The interaction between two extremely finely dispersed components will occur far below the melting point of the metal on account of the extremely high surface energy of the fine powder particles. Wetting, assisted by direct lattice fit, can be considered under conditions intermediate to macro-wetting and solid wetting, especially where very fine ceramic powders will be wetted by considerably larger metal powder particles and wetting will occur close to the metal melting point. According to Williams and Murray, the high surface energy of the finely divided ceramic is associated with distortion and disorder in the surface layers, and a proportion of these imperfections are effectively lattice "vacancies," since their concentration is of a higher order than that normally encountered in coarser material. The total number of surface vacancies may then be sufficient to permit a reasonable number of metal ions (provided their size is not prohibitive) to fit directly into the ceramic lattice. Since both anion and cation vacancies are envisaged, the "fitting" process could be aided by diffusion of oxygen atoms, a relatively small number having a considerable effect on the wetting ability of the metal. In this case the process might be thought of as a short-range dilute solid solution, with the zone of interaction limited to a surface layer of the order of 100 A in consequence of the steep vacancy concentration gradient in the surface layers and the small number of atoms involved.

Compound formation in a bonding phase can best be shown by the examples of spinels having the generalized formula $RO.R'_2O_3$ where R′ could, for example, stand for Ni, Mg, Fe++ or Co, and R for Al, Cr or Fe+++. The German firm of Siemens was probably the first to consider the Al_2O_3–Fe cermets, and a great deal of work has been done on this system without achieving the combination of properties required for the high-temperature engineering applications in view. However, some other likely combinations involving a spinel bond may yield a satisfactory cermet.

For carbide cermets, instances of definite compound formation as an adjunct of bonding are not so readily found. The example of Co-bonded WC might be quoted, in that an intermediate n-phase is formed consisting of double carbides with the generalized formula $Co_xW_yC_z$ (e.g., Co_3W_3C). Although this phase plays an intermediate role in forming an effective bond, its brittleness renders it undesirable and careful control of forming conditions excluded it from the final product.

One of the main problems in the development of cermets is the wetting action which takes place between the metallic and the ceramic component. It is well known that metals bond considerably better to metalloids than for example, to oxides, and that a gradual transition consisting of metal-metalloid-ceramic composition with solid solution between metalloid and ceramic component

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components is of prime importance for any study of bonding. Low interfacial energy is equivalent to strong bonding. In the production of cermets, the compacted composite powders are frequently sintered under conditions which result in a molten stage of the metal component; the wetting properties between the metallic and ceramic particles are, therefore, essential for the quality of the bond. Kingery's investigations are basic for any development of new cermet materials and concern especially the interfacial energies between the various cermet components. One has to consider that the manner of distribution of the metallic component in a polyphase, polycrystalline alloy is strongly affected by the interfacial energies of the system. Whenever a cermet structure contains a metallic phase present in isolated pockets, the physical properties of the cermet material will be fairly similar to those of the ceramic phase. However, whenever the metallic phase is distributed in the form of a continuous film between the ceramic particles, the properties of the cermet may considerably deviate from that of the individual components. Kingery's extensive studies on wettability and surface energies of metallic-ceramic systems are, therefore, of prime importance. This investigator used the "sessile drop method" as described by Ellefson and Taylor. For a drop of liquid metal resting on a solid, as shown in Fig. 2, the contact angle at equilibrium is determined by the surface energy of the solid, the surface tension of the liquid metal, and the solid-liquid interfacial energy. These equations govern correlations between variables:

$$\tau_{S\text{-}L} = \tau_{S\text{-}V} - \tau_{L\text{-}V} \cos\theta$$

where $\tau_{S\text{-}L}$ = solid-liquid interfacial tension

$\tau_{S\text{-}V}$ = surface tension of the solid

$\tau_{L\text{-}V}$ = surface tension of the liquid

θ = contact angle ranges from 0° for complete wetting to 180 when there is no tendency at all for the liquid metal to spread.

$$W_{AD} = \tau_{L\text{-}V} (1 - \cos\theta)$$

where: W_{AD} = the work of adhesion

The sessile drop method permits calculation of the surface energy and contact angle from measurements of the drop parameters, whose shape in equilibrium depends on gravitational and interfacial forces. Contact angle and surface tension depend on the component materials, their surface conditions, and on the atmosphere in which the reactions take place. The physical properties of cermets, therefore, depend strongly on the atmosphere of sintering. Table II shows the conditions under which nickel reacts with some oxides and carbides in vacuo, hydrogen and helium atmospheres at 1500° C; it can be seen that the smallest contact angle occurs in vacuo and the largest one in hydrogen.

Table III shows that the work of adhesion in various cermet systems depends on the sintering atmosphere, and that for many cermets the highest work of adhesion is in connection with sintering in vacuum. One has to take into consideration, however, that although the bond strength is determined by the interfacial energy, this strength is also affected by other variables.

The final part of this paper will appear in December.

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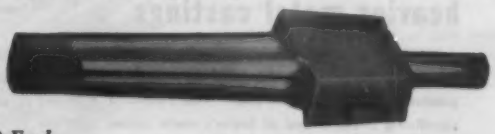

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HIGH STRENGTH STEELS

continued from page 40

tion: "What do we measure?", is concerned, this must certainly be determined by the application being considered. A minimum list of properties normally includes the following: 1. Tensile 2. Yield 3. Elongation 4. Reduction of Area 5. Impact.

Additionally desirable may be the effect of temperature on 1 through 5 above, creep and/or stress-rupture, tempering resistance and endurance limit. Beyond these purely mechanical measurements which we must make for our customers, we must be prepared to evaluate for control purposes, the effects of melting practice, deoxidation, heat treatment, and analysis variables. It is the aim of this paper to show how some of these variables react on a series of relatively low alloy, martensitic steels and to point out some directions which seem to require active additional work.

First let us look at the test bar, as it is the basic shape with which we must work in our alloy evaluation.

The clover leaf bar, figure 1, has proved comparable to the commonly accepted keel blocks and, because the yield is 8 good bars for 45 pounds poured compared to 2 bars per 35-50 pounds in the keels, we have selected this as our standard for test and control purposes. A major portion of the data contained here will, therefore, have been obtained using the clover leaf type of bar. Significant exceptions will be noted.

With a test bar established, what variables are worthy of exploration? 1. Deoxidation Practice 2. Melting Methods 3. Chemistry and Heat Treatment (a) For essentially room temperature service (b) For elevated temperature service.

Each alloy has an ultimate potential which is higher than we can expect to reach on every try. On the other hand there is practically nothing we can do in error which will make a result come out higher than its actual value. We can, therefore, attach a definite significance to those occasional heats that perform above normal. They indicate what is really available in the alloy when we do everything right.

After exploring a number of commercially available deoxidants, we have settled on two which for our shop, using induction melting, seem to do the best job. Further comparisons to establish a final selection are still in progress. The currently favored practices are: 1. Six pounds per ton of CaMn Si in the ladle just prior to tap + .08% Al wire at one-half tap. 2. Five to ten pounds per ton of CaSiAl.

Other deoxidants tried have included Ti and Zr compounds.

In this area it is somewhat dangerous to generalize, but certainly one of the fundamental purposes of deoxidation treatments is to control inclusion distribution and shape in the final product. Metallographic examination and correlation with mechanical properties will allow the selection of the best practice for a given shop. For example, Figure 2 illustrates the round and random salt and pepper shaped inclusions obtained with both of the Ca bearing deoxidation treatments. Figure 3, a Zr deoxidation, shows a grain boundary inclusion distribution associated with potentially low ductility. Charpy bars for these two samples ran 15-18 foot pounds for the CaMnSi treatment and 8-10 foot lbs. for the Zr deoxidation.

Melting methods can also con-

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tribute to good, better, or best properties. Many heats of multiple low alloy steels indicate that, all other things being equal, we obtain our best properties by arc melting. This does not mean that existing specifications cannot be met by induction melting.

To date, it merely seems to mean that the arc furnace with its boil and its controlled slag improves the chances of obtaining exceptional properties. These comparisons are based solely on air-melting. Vacuum or other controlled atmospheres are not included in this generalization.

The discussion of chemistry and heat treatment will be confined essentially to martensitic low alloy steels and will deal with four major phases: 1. The carbon effect 2. The silicon effect 3. The dehomogenization temperature effect. 4. The reproducibility of properties at 180,000 psi and above.

The lower curve of Figure 4 relates the carbon content and ultimate tensile values of a series of low alloy steels subjected to the following heat treatment: 1850° F—2 hrs—Air Cool, 1650° F—4 hrs—Oil Quench, 400° F—6 hrs—Air Cool.

The upper curve is a segment of the curve presented by Bullens[1] relating maximum achievable hardness to carbon content. For illustrative purposes the R_c hardness values of the original curve have been converted to tensile strengths. It may appear that the ultimate tensile values of the cast alloys, although parallel, fall far short of the ideal values shown in the upper curve. A more practical viewpoint, however, is to consider that wrought .40% carbon alloys are just reaching acceptance at the 260,000 psi strength level. Picking up the .40% carbon and 260,000 psi intercept and paralleling the existing curves indicates that as far as ultimate is concerned, the cast alloy is comparable.

Two things are evident from this plot as far as low alloy martensitic steels are concerned: 1. As long as section size and hardenability are ruled out, the maximum useable strength obtainable is determined by the amount of carbon put in the alloy while still maintaining an acceptable level of ductility. 2. To obtain reproducible properties at a given strength level and with a given heat treatment, carbon control in the foundry must be very good.

The effect of silicon on impact strength and its relation to tempering temperatures has been well explored in wrought alloys by Cohen[2] and others. Because of the significance of this silicon effect and its relation to selection of tempering temperatures consistent with adequate stress relief, this effect has been explored in a series of cast alloys in the .30% carbon range. Figure 5 illustrates the properties of a .42% Si steel homogenized at 1850° F, water quenched from 1650° F and tempered as shown. Note the decline in impact starting above 400° F and continuing until the tempering temperatures reach about 800° F, after which a rapid rise occurs. The maximum value shown is 42 foot pounds at an 1100° F tempering temperature.

Continued on page 108

By contrast, Figure 6 shows a similar set of properties for a 1.60% Si steel. Note that the reduction in Charpy impact values does not start until about 600° F, and that even at 1100° F the energy absorbed is only 26 foot pounds compared to 42 foot pounds in the .42% Si alloy. This embrittlement effect is pushed even farther up the tempering temperature scale if silicon is fur-

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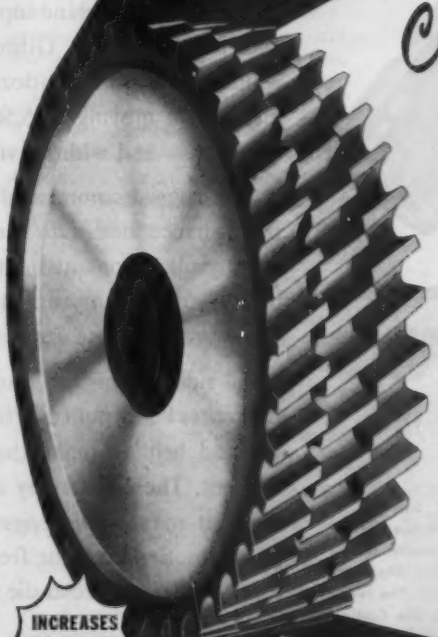

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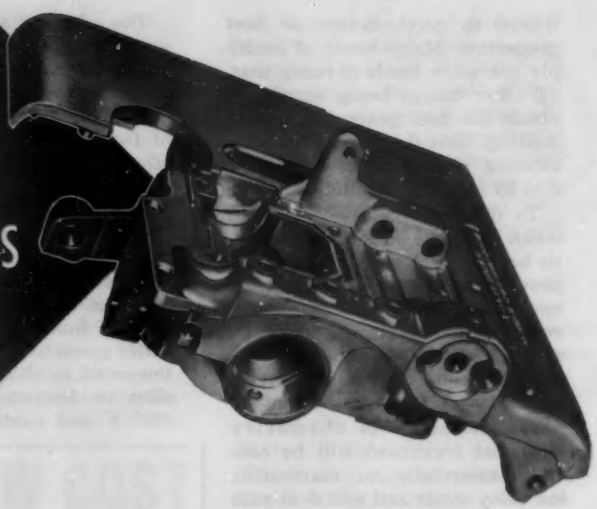

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TECHNOLOGY, MARKETS DISCUSSED BY DIE CASTERS

The American Die Casting Institute, representing the leading custom die casters in the United States, met in Chicago on September 18 and 19 for their annual meeting. Technological changes and new marketing areas were the principal topics brought out in the discussions.

ADCI PRESIDENT

Clifford Sheehan

VICE PRESIDENT

Clifford Anthony

AWARD WINNER

James N. Smith

A review of the past year's activities showed that the die casting industry is continuing to grow at a more rapid rate than general industrial growth, indicating that an ever greater number of designers are turning to die castings for components that previously would have been fabricated by some other method.

Looking to the future, however, the members of the ADCI feel that technological improvements and buyer education are the keys to the further expansion of the industry.

To maintain its leadership the die casting industry actively supports a broad research program leading to the development of new and better die lubricants and lubricators, new temperature control systems, more durable cores and new die materials.

The Institute's die casting research program is showing major progress in acquiring knowledge of the mechanism of heat checking in dies. This will lead to the economic die casting of high melting-point metals such as brass and, ultimately, the ferrous metals.

OFFICERS RE-ELECTED

Officers for the next year were elected. Clifford J. Sheehan, of the Aluminum Co. of America, was re-elected president; Clifford L. Anthony, of the Hoover Co., was re-elected vice president; and David Laine and W. J. Parker, of the American Die Casting Institute, were re-elected secretary and treasurer respectively.

New directors are: W. G. Newton Jr., of Newton-New Haven Co., representing the eastern regional group; C. L. Anthony, of The Hoover Co., representing the central regional group; Walter E. Brown, of the Kiowa Corp., representing the midwestern regional group; Gene Woods, of Aluminum Die Casting Co., representing the Pacific coast regional group; and Matthew M. Berman, of L. E. Mason Co., director at large.

DOEHLER AWARD

Die casting's highest honor went, this year, to James N. Smith of the Aluminum Company of America. This was the annual Doehler award.

In making the award, Fred W. Burgie, representing the Institute's board of directors, sited in particular Mr. Smith's counsel, guidance, and leadership as chairman of the Engineering Committee and an engineering member of the Committee on Standards of

Continued on next page

REGIONAL CHAIRMAN

NEW chairmen by regional groups are: upper left, Alfred Schneier, Eastern Regional; right, Walter Brown, Midwestern; lower left, Robert Kopper, Central; and Paul Harlow, Pacific Coast, right.

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ADCI—continued

the ADCI. This committee was largely responsible for the development of the engineering standards and the complete program of "Product Standards for Die Castings."

Mr. Smith joined Alcoa in 1929 to operate the Cleveland Die Casting Div. In 1931 he became chief engineer at the Garwood, N. J. die casting plant and in 1948 assumed direction of the Chicago plant. He was largely responsible for the layout and design of the Chicago plant. Smith is now in charge of layout and design for a new die casting plant to be built by Alcoa at Edison, N. J.

EDUCATION

In the field of consumer education, a new program was announced at the meeting. This program will be aimed at engineering students who represent tomorrow's die casting buyers. Through practical experience and study these students will learn the basic principles of die casting. The first of these educational programs to go into effect will be at Penn State University. A

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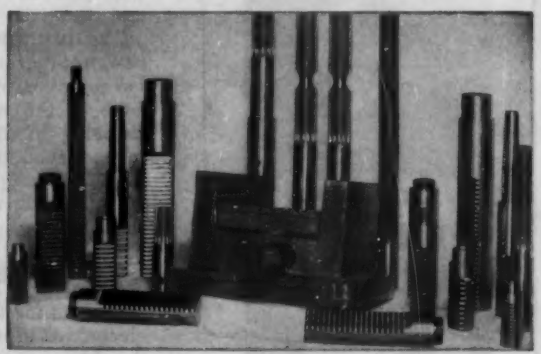

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die casting machine has been contributed by an Institute member company; two annual scholarships have been awarded; cash awards will be given for outstanding papers on die casting; visual aides, including motion pictures, reference books and technical data; a staging of a Clinic-Exhibit and a permanent die casting display. In addition arrangements will be made for student field trips and summer employment in die casting plants.

TERPENNING VICE PRES., FOUNDRY PRODUCTS

Julian A. Terpenning

The appointment of Julian A. Terpenning to the position of Product Manager, Foundry Resins, was made by Warner Bishop, Vice President, Foundry Products Division of Archer-Daniels-Midland Company, Cleveland, Ohio.

The promotion is another step in the company's continuing effort to align service activities with the foundry industry's need for increased technical assistance in the use of advanced special purpose sand additives, a field in which ADM now leads by a wide margin with the recent acquisition of Federal Foundry Supply Company, Cleveland.

Mr. Terpenning, previously an ADM Technical Service Engineer in the Lancaster, Pa. area, will immediately assume his new duties in ADM's Newark, N. J., resin laboratory. He will plan and direct technical formulation and service in connection with both solid and liquid foundry resins. His extensive experience in the specialized field of resins and shell molding well qualifies him for this important assignment. He has previously been associated with Shell Process, Inc., Metal and Alloy Specialties Co., Inc., Curtiss-Wright Corp., and Foundry Products Division of the Borden Company.

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Circle No. 47 on the Reader Service Card

BRUSH BERYLLIUM OPENS NEW METAL PLANT

The Brush Beryllium Co., of Cleveland, Ohio, announced the completion of its new plant at Elmore, Ohio, this month. The new installation will be used for the production of beryllium metal.

The new plant and office buildings are located adjacent to the company's beryllium alloy plant.

NEW PLANT built by the Brush Beryllium Co. at Elmore, Ohio, was financed at a total cost of $4,500,000.

The plant dedication and open house are scheduled for the middle of this month and at that time the public will be invited to see and inspect the new facilities.

Brush Beryllium also announced that the new plant was privately financed at a total cost of about $4,500,000. It is designed so as to be able to produce 20,000 lbs. of beryllium a month in hydroxide form. It is also equipped to produce 10,000 lbs. of vacuum cast beryllium each month.

The metal produced is used extensively in the construction of nuclear reactors and is also being studied for possible use in missiles, aircraft, and air borne devices.

Since its formation in 1931, Brush Beryllium has grown and expanded steadily. The completion of the new Elmore, Ohio, plant is the firm's latest step toward larger production capacities of beryllium metal.

At the present time, a wide variety of uses are being made of beryllium and it has many important industrial applications.

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SHEA, DIV. MANAGER, LINDBERG INDUSTRIAL CORPORATION

Lester A. Shea

The appointment of Lester A. Shea as Eastern Division Manager was announced by R. A. Schoenfeld, Executive Vice President, Lindberg Industrial Corporation, Chicago, manufacturers of large custom-built, field erected heat treating, melting and production line equipment.

Mr. Shea has over 30 years of experience in the industrial heat treating and melting field and will supervise Lindberg Industrial Corp. activities through the Eastern Area Office located at 12-96 Plaza Rd., Fair Lawn, N. J. He became associated with Lindberg in 1937 when he joined Lindberg Engineering Company.

He is a member of the American Foundrymen's Society, and American Institute for Management. He served five years on the executive board of the Chicago Chapter A.S.M.

JOHNSON JOINS MACDERMID, INC.

MacDermid Incorporated manufacturer of metal cleaning, plating and finishing chemicals, recently announced the appointment of Fred Johnson as Sales Engineer. He has been assigned to assist Cecil Thornton covering the New York State area from Rochester, New York.

SANDSTEDT JOINS MICHIGAN-STANDARD

Donald A. Sandstedt has joined Michigan-Standard Alloy Casting Co. and Misco Fabricators, Divisions of Michigan Industries Co. as Manager of Sales for Chicago, Milwaukee and Wisconsin areas, his Chicago address being 80 East Jackson Blvd.

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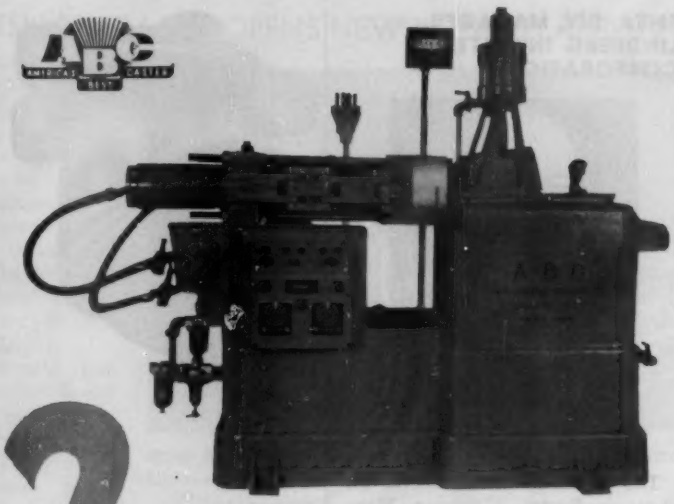

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WHEELABRATOR CORP. MAKES SALES STAFF CHANGES

George F. Burditt has been appointed Manager, Steel Mill Equipment Sales Division, Wheelabrator Corporation, Mishawaka, Indiana. Joseph F. Underway, previously District Manager of Wheelabrator Corporation's St. Louis Office, has been transferred to the Pittsburgh territory where he replaces G. F. Burditt. John B. Booth has been appointed Sales engineer in the Los Angeles sales office. Francis E. Noyes has been advanced to District Manager of the St. Louis sales territory. Wayne L. Hungate has been assigned to the St. Louis Territory as a Sales and Service engineer. William A. Illsley, Sales engineer in the Detroit territory has been appointed District Manager of the Cincinnati territory. He replaces Russel Duer who died July 4, 1957. William E. Scherrer has been appointed Sales engineer in the Cincinnati territory.

KIRK ELECTED DIRECTOR NATIONAL LEAD CO.

J. Paul Kirk has been elected to the board of directors of National Lead Company.

Mr. Kirk is president and a director of Morris P. Kirk & Son, Inc., a National Lead subsidiary with operations on the West Coast producing lead and zinc alloys, fabricated lead goods and lead oxides. He is also president and a director of another company subsidiary, Pioneer Aluminum, Inc. of Los Angeles, manufacturers of aluminum tooling plate for the aircraft and other industries and a distributor of aluminum bar, rod, sheet and aircraft extrusions. His headquarters will remain in Los Angeles.

Mr. Kirk succeeds H. T. Warshow, who has retired after 36 years of service.

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COLWELL SPEAKER AT S.D.C.E. CHICAGO CHAPTER

The first Fall meeting of the SDCE, Chicago Chapter, was held October 3. Speaker was Mr. Donald L. Colwell, Director of Laboratories of Apex Smelting Co., Cleveland. His subject was "Aluminum and Zinc Alloys in the Die Casting Process".

H. M. WEBBER JOINS HARPER ELECTRIC FURNACE

H. M. Webber

H. M. Webber has been appointed Manager of Process Engineering for Harper Electric Furnace Corporation, Roderick L. Harper, executive vice president,

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announced recently.

"Mr. Webber is recognized as one of the nation's outstanding authorities on furnace brazing and sintering, as well as on protective atmospheres," Mr. Harper said. "We are confident that his wide knowledge and experience will enable Harper to continue setting the pace in the field of high temperature electric furnace design and application."

As a part of his process engineering responsibilities, Mr. Webber will direct a greatly expanded program for the development and promotion of the Harper line of continuous brazing and sintering furnaces.

A graduate of the University of Colorado with a B.S. Degree in Electrical Engineering, Mr. Webber has been an application and process specialist with the Industrial Heating Department of the General Electric Company for the past 30 years. Concentrating on controlled atmosphere furnaces, he has gained recognition throughout the industry for his knowledge on furnace brazing. He has also made important contributions in the field of powder metallurgy.

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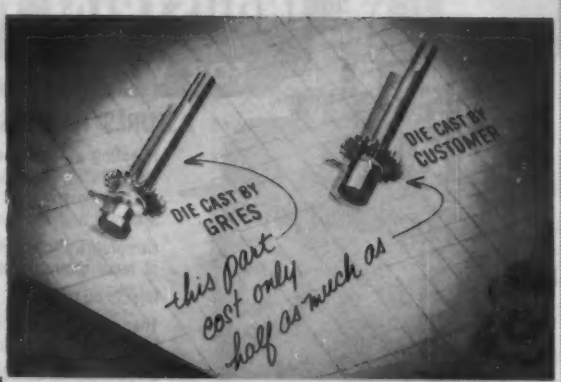

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- REDUCE DOWN TIME
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These are only a few of the savings you make when the Dorsey Automatic Piston and Cylinder Lubricator is installed on your aluminum cold chamber die casting machines.

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The Dorsey Automatic Lubricator permits precise control of the amount of lubricant used. The correct amount of lubricant being introduced at every cycle, eliminates the waste and mess of too much lubrication and prevents damage caused by too little lubrication.

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The design is efficient and extremely simple with nothing to get out of order and cause maintenance problems. Each stroke of the plunger activates the Dorsey Automatic Lubricator assuring full coverage of both the cold chamber and plunger.

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seem but a simple repetition of available data on wrought alloys, yet it represents one of the things we must know about cast products when customers ask for engineering data. It also points out the danger in attempting to apply the higher silicon grades in anything but the high strength levels.

We have worried considerably about various methods of obtaining adequate and reproducible ductility as carbon increased significantly over .30%. This worry has been coupled with a companion concern over how to get the stabilizing elements into the alloy which would give a moderate degree of heat resistance and still maintain high strength with a useable amount of ductility. The problem is compounded by the fact that the attractive alloys for heat resistance in this range, chromium, molybdenum, and vanadium, are all carbide stabilizers of varying degrees. A 6%

TABLE II
RESISTANCE TO TEMPERING OF A CAST 6% CHROMIUM STEEL

NOMINAL ANALYSIS

Mn%	Si%	Cr%	Mo%	V%
.75	.75	6.00	1.50	1.00

Heat Treatment	C%	Tensile	Yield	%El.	%RA
1800°F-6 -AC	.55	185,000	———	—	—
1100°F-3 -AC	.33	220,000	———	1.0	1.4
2280°F-12-AC	.54	210,000	———	7.0	15.5
1800°F-3 -AC	.33	216,000	182,000	7.0	18.9
2280°F-12-AC	.29	224,000	193,000	6.5	14.4
1800°F-3 -AC	.41	222,000	187,000	3.0	4.3
1100°F-3 -AC	.42		192,000	3.5	4.7

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chromium die steel at about .40% carbon looks like Figure 7 after a homogenization at 1850° F, an air cool, and an 1100° F temper. Note the prevailing carbide network indicative of grain boundary segregation is evident.

Consider however, Figure 8 which shows this same alloy, heat treated in the same manner except for the addition of a prior cycle at 2280° F for 4 hours followed by an air cool. The carbide grain boundary net work is almost destroyed and one would anticipate a substantial reflection of this metallographic change in the measured mechanical properties. Table I shows the effect of such a high temperature homogenization on a .29% carbon, 6% chromium die steel.

Elongation and reduction of area are raised to respectable and useable values with little sacrifice in tensile and yield strengths. What is more important is that these properties in excess of 200,000 psi are obtained with a tempering temperature of 1100° F.

TABLE I
EFFECT OF HIGH TEMPERATURE HOMOGENIZATION ON A CAST 6% CHROMIUM STEEL

ANALYSIS

C%	Mn%	Si%	Cr%	Mo%	V%
.29	.88	.83	6.25	1.50	.99

Heat Treatment*	T.S.†	Y.S.†	%El.	%R.A.
1800°F-6	230	191	4.0	7.4
1100°F-3	229	181	4.0	4.7
1800°F-6	212	179	4.0	10.4
2280°F-4	211	182	8.5	26.5
1800°F-6	213	181	8.5	25.4

*All air cooled
†Strength in thousands

If we assume that one of our aims is not only a material which will maintain high strength after a high tempering temperature, but will also be stable at operating temperatures near this tempering temperature, we can find some hopeful evidence in Table II. These data indicate the stability available after 100 hours at 800° F. They further confirm the benefits of a 2280° homogenization.

References

(1) D. K. Bullens, "Steel and Its Heat Treatment," Volume I, 1948.

(2) C. H. Shih, B. L. Averbach, and Morris Cohen: "Some Effects of Silicon on the Mechanical Properties of High Strength Steels," Transactions ASM 48, (1955).

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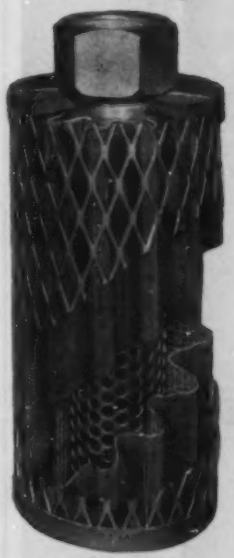

SUMP TYPE (cutaway)

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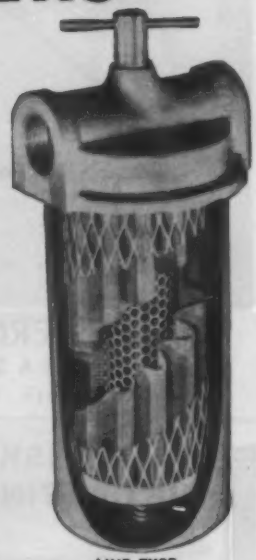

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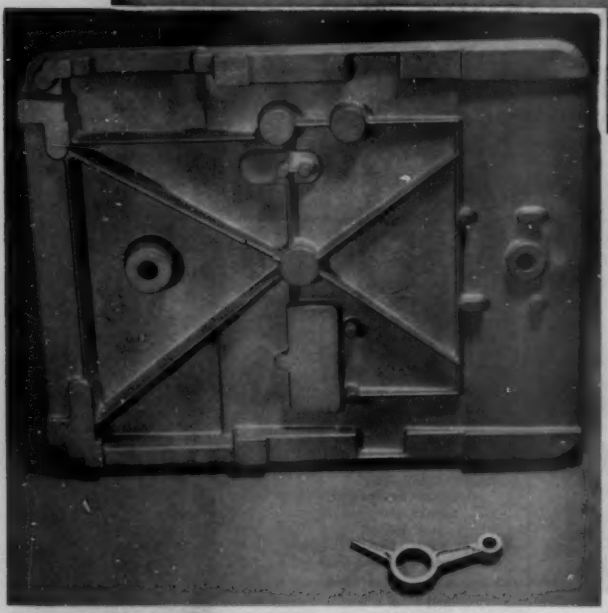

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TITANIUM

continued from page 49

tensile strengths of some heat treated alloys reported as high as 190,000 psi, this expensive metal is still a cheap structural material in those instances where every pound saved may mean one or more miles of useful range, or several pounds of additional payload.

Most conventional titanium alloys are limited to a maximum operating temperature of 800° F, but new alloys under development show promise of raising this figure. Practically all of these alloys are castable, and the techniques are rapidly approaching the point of proficiency where sound aircraft quality castings will be available to the industry.

Because of the extreme reactivity of these metals at their high temperature melting points, elaborate precautions must be taken in the melting and casting processes. All oxygen, nitrogen, and hydrogen gases must be excluded. Even water and carbon dioxide will break down to their elements and cause contamination if allowed to come in contact with

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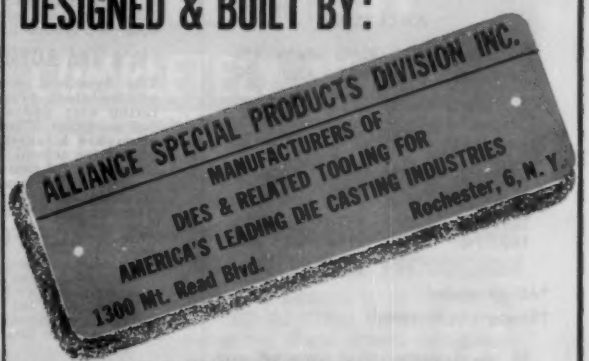
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zirconium or titanium at temperatures near their melting points. In addition, these metals when molten will react with all known refractories. At the present state of the art, the most successful method of producing castings is vacuum melting by consumable electrode arc in a water cooled copper crucible, and pouring directly from this crucible into graphite molds. The graphite found most desirable from the purity and size range point of view is National Carbon Co's. grades AUC, ATL and CS. This phenomenon of actually obtaining superheat in metals which melt at over 3000° F (while contained in a copper crucible which has a melting point of less than 2000° F cooled by water held below its boiling point of 212° F) requires highly specialized equipment and well-trained operating personnel. In addition to the problems of melting, the affinity of these metals for mold materials, even graphite, requires pouring into relatively cold molds if contamination is to be avoided.

Despite these process peculiarities, castings are being produced, in most cases at a cost lower than comparable parts fabricated by other means, and with physical properties very closely approaching those of the wrought metal. Basically, principles of metal flow and progressive solidification employed in static casting of the more conventional metals may be employed in designing for casting of zirconium and titanium. If the designer will also remember that generous draft and absence of re-entrant angles will give longer mold life, that blind cores may be difficult or impossible to remove, and that chills and chaplets are not effective in machined graphite molds, and modify his design to suit these conditions, good quality castings at an attractive price are available. In general a shrinkage allowance of 0.010 to 0.012 inches per inch is used in mold design.

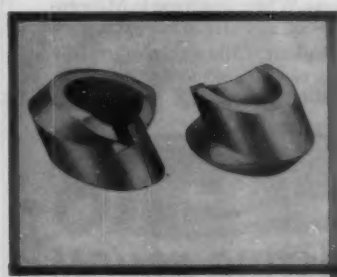
At present, the majority of castings in these metals are in about the five pound size range, but 75 pound castings have been produced, and larger sizes are expected in the very near future.

At this time no standards have been established for soundness of titanium and zirconium castings. Pending establishment of these, use is being made of ASTM E-71-52, Industrial Radiographic

Continued on next page

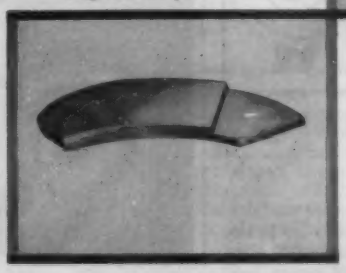
Basic Considerations in Selecting alloys . . . . for your INVESTMENT CASTINGS

DO YOU KNOW THAT . . . an investment casting produced from a low cost metal may be MORE EXPENSIVE than one cast from higher priced material that may also have characteristics better suited to your requirements.



These angle connectors were originally investment cast in mild steel, a low cost material. To overcome corrosion problems, 303 stainless was substituted and because of its better castibility there was no increase in cost. Now, silicon brass is being used at a 10% saving on the original selling price.

This gage mount is an excellent example of unusually good casting characteristics of one metal offsetting a decidedly higher material cost. Originally priced in SAE 8620 steel, it was changed to beryllium copper at a 15% saving in unit price.



This simple textile machine part requires a high degree of wear resistance. Casting in the right metal provided better properties at lower cost than when machined from tool steel.

Get more complete information for this is only a small part of the story telling how the right metal selection for investment castings can often increase efficiency and reduce costs.

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Generally, ± 0.005″/in. can be readily obtained. Closer tolerances can be reached, but only at greater cost. As-cast surfaces are generally considered to be quite good, and fine mold detail is faithfully reproduced, as shown in the cast titanium book end. Other illustrations depict castings made for special applications.

In summary, it may be said that castings of titanium and zirconium are expensive, and because their reactive nature requires elaborate precautionary measures during their production, they probably will always remain expensive, but in those applications where they should be used, they are the cheapest components available.

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Mr. Chapdelaine joined the Conversion Chemical Corporation a little over a year ago and has been active in product research and marketing. Prior to his joining Conversion Chemical Corporation, he served first as chemist and later as supervisor of the finishing department of the Underwood Corp., Hartfort, Conn.

HARBISON-WALKER

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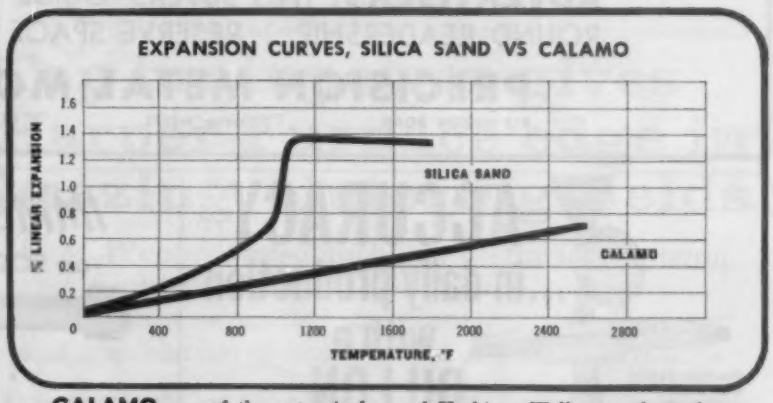
for precision metal casting



CALAMO, one of the extensively used Harbison-Walker products for investment molding is an aluminum-silica refractory of optimum sizings for various particular mixtures. Its fusion point is 100°F. higher than that of normal silica sand mixes.
The chart above shows the exceedingly desirable expansion curve of CALAMO as compared with that of silica sand. CALAMO used as the major constituent of investment mixes, improves the dimensional constancy of the molds and makes them stronger and more resistant to erosion.
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JANUARY, 1958

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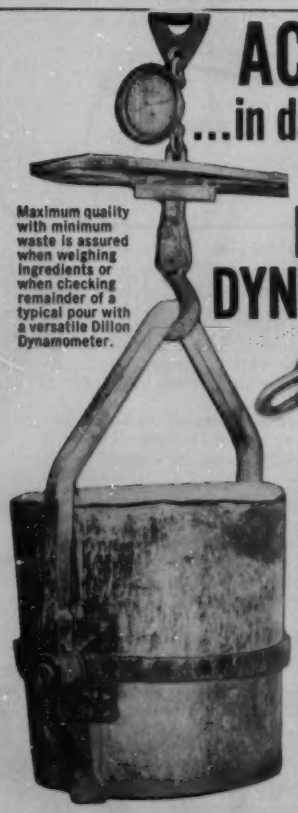

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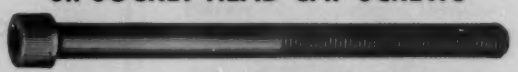

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Roderick L. Harper, Executive VP and H. M. Webber, new Manager of Process Engineering, discuss brazing furnace during construction.

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A prolific writer of numerous articles and technical papers, he has co-authored the book "Protective Atmospheres," and produced one of the most complete treatises ever published on furnace brazing. Recognized throughout the industry as an eminently well-informed lecturer and consultant, soft-spoken "Pete" Webber displays a keen perception of customers' problems that inspires immediate confidence.

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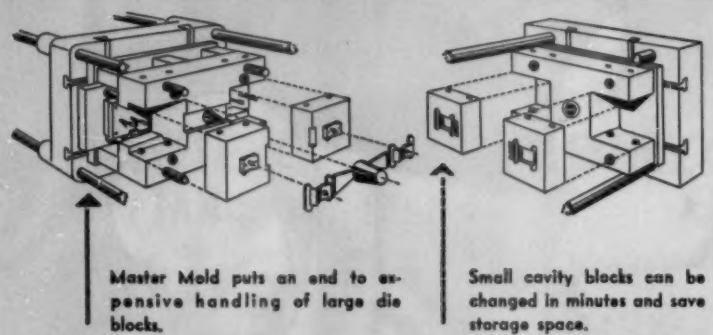

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